PART 2

Guidance on Specific Biological Assessment Topics

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4.0 Components of a Biological Opinion

4.0 Components of a Biological Opinion

A biological opinion is the document prepared by NOAA Fisheries or USFWS (referred to commonly as the Services) as part of the formal consultation process, to be issued at the culmination of this consultation process. This chapter provides a brief overview of the components of a biological opinion.

In general, a biological opinion is required when an action (e.g., construction activity) is estimated to adversely affect an ESA-listed plant or animal species. Depending upon the species in question, NOAA Fisheries or USFWS issues a biological opinion on the effects of the proposed action on the affected ESA-listed species. If the agency concludes that the species will be unaffected, the proposed action receives a *no-jeopardy* biological opinion and continues as planned. If the proposed action is found to *jeopardize* a species, the federal government may require additional mitigation measures or deny the project. If the proponent can satisfy the recommended mitigation requirements, the proposed action can proceed.

An example of a biological opinion outline is provided below. Each of the sections included in a biological opinion is discussed in detail in this chapter:

I. Consultation history

II. Description of proposed action

III. Description of action area

IV. Status of species and critical habitat

- A. Species and critical habitat description
- B. Life history
- C. Population dynamics
- D. Status and distribution
- E. Analysis of species and critical habitat likely to be affected

V. Environmental baseline conditions

- A. Status of species within the action area
- B. Factors affecting species environment within the action area

VI. Effects of the action

- A. Factors to be considered
- B. Analyses of effects of the action
- C. Species response to the proposed action

VII. Cumulative effects

VIII. Conclusion

IX. Reasonable and prudent alternatives (as appropriate)

X. Incidental *take* statement

   A. Introductory paragraph

   B. Amount or extent of *take* anticipated

   C. Effect of the *take*

   D. Reasonable and prudent measures (as appropriate)

XI. Terms and conditions

XII. Conservation recommendations (as appropriate)

XIII. Reinitiation statement

XIV. Literature cited

4.1 Consultation History

This section of a biological opinion provides a brief overview of the consultation process. This section would describe any pre-consultation activities, and identify when consultation was initiated, if the consultation period was extended, the date of reinitiation of consultation if applicable, whether additional information was requested and when it was received. This section also indicates that a complete administrative record of the consultation has been filed and where these files can be accessed.

4.2 Description of the Proposed Action

This section provides a detailed description of the proposed action: all primary and secondary construction elements, timing, equipment, impact minimization measures, etc. Essentially this section deconstructs the action into its constituent elements, explains how and when these elements will be implemented, and explicitly identifies what measures have and will be taken to minimize potential impacts.

4.3 Description of the Action Area

This section identifies the geographic extent of the action area and provides rationale for how the limits of the action area were determined. The action area envelops all areas that could sustain direct or indirect impacts associated with the proposed action as well as any interrelated or interdependent activities.

4.4 Status of Listed Species

This section provides an overview of the federal status of the listed species, identifies the delisting goals for species, and describes the conservation needs of the species (pertaining to habitat, behavior, and life history requirements).

This section also characterizes the federal status of designated critical habitats and describes the primary constituent elements of these habitats.

4.5 Environmental Baseline Conditions

This section of the biological opinion describes the environmental setting and environmental conditions within the action area. Often the section is divided into detailed descriptions of specific habitat components such as wetlands, riparian areas, upland areas, and developed areas. The environmental baseline discussion describes the physical and biological characteristics of habitats in the action area generally and also as they pertain to particular species or life stages of species. This section also describes the history of disturbance to these habitats.

The status of species within the action area is also summarized in this section, along with the conservation needs of the species within the action area. The environmental baseline discussion also characterizes habitat conditions within the action area as they pertain to designated critical habitats.

4.6 Effects of the Action

This section provides a detailed analysis of the direct and indirect effects of the proposed action on listed species and any effects associated with interrelated and interdependent actions or activities. The analysis includes detailed exposure analysis, response analysis, and risk analysis for each of the species addressed in the biological opinion. The exposure analysis identifies the effects of the action that will likely overlap with species presence within the action area. The response analysis determines how listed species are likely to respond after exposure to these effects. The anticipated responses are based upon information in peer-reviewed literature, field studies, and reports from previous projects. The risk analysis determines the overall risk of the project for each listed species by comparing the exposure and response analyses.

This section also analyzes potential project impacts as they pertain to the primary constituent elements of designated critical habitats.

4.7 Cumulative Effects

The cumulative effects analysis is confined to the action area defined for the proposed project and assesses the effects of future state, tribal, local, or private actions that are reasonably certain to occur. This section of the biological opinion analyzes cumulative effects and assesses the risks to listed species and designated critical habitats that are associated with individual activities.

4.8 Conclusion

This section summarizes the analysis provided in previous sections of the biological opinion and concludes whether the proposed project would or would not jeopardize the continued existence of a listed species, and would or would not destroy or adversely modify designated critical habitat.

4.9 Incidental *Take* Statement

Section 9 of the Endangered Species Act and federal regulations issued pursuant to Section 4(d) of the ESA, prohibit *take* of endangered and threatened species, respectively, without a special exemption. An incidental *take* statement provides action agencies with specific terms and conditions that, if complied with, will ensure that taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking under the ESA. The incidental *take* statement specifies the amount or extent of *take* that is authorized, the effect of this *take* on the species, and reasonable and prudent measures that are necessary and appropriate to minimize incidental *take* of a listed species. The specific terms and conditions providing exemption from the prohibitions of Section 9 of the ESA are included in a separate section, described below.

4.10 Terms and Conditions

The terms and conditions section provides nondiscretionary requirements that an action agency must implement in order to ensure their exemption from Section 9 prohibitions. If the amount or extent of incidental *take* allowed in the previous section is exceeded, the action agency must reinitiate consultation and provide an explanation of the causes of the taking. The action agency and the Services will also review the reasonable and prudent measures originally provided to determine if modification is needed.

4.11 Conservation Recommendations

Conservation recommendations included in a biological opinion are discretionary agency activities to further avoid or minimize adverse effects on listed species or critical habitat resulting from a proposed action, to help implement recovery plans or to develop information. The Services request that they be informed if and when the recommendations are implemented.

4.12 Reinitiation Notice

The reinitiation notice informs federal agencies that they are required to reinitiate consultation with the Services if the following conditions apply:

- The amount or extent of incidental *take* is exceeded.
- New information reveals potential effects of the agency action on listed species or critical habitat in a manner or to an extent not considered in this opinion.
- The agency action is subsequently modified in a manner that results in an effect on the listed species or critical habitat not considered in this opinion.
- A new species is listed, or critical habitat is designated, that may be affected by the action.

4.13 Literature Cited

All of the personal communications and literature citations in the biological opinion are compiled into a standard reference list.

5.0 Endangered Species Act and Mitigation

5.0 Endangered Species Act and Mitigation

Chapter Summary

- Under Section 7 of the Endangered Species Act, federal agencies are directed to use their authority to support ESA programs for the conservation of listed species and the habitats upon which these species depend.
- Recovery of species is not achieved on a project-by-project basis.
- Section 7 requires action agencies to minimize the level of *take* associated with each project by avoiding or minimizing project impacts to species and habitats.
- There is no requirement that action agencies mitigate for incidental *take*.
- For projects undergoing formal consultation, the addition of mitigation to a project cannot result in an informal consultation. If *take* will occur, the project requires formal consultation.
- The Services cannot require major changes to projects, and any suggested changes to projects should be directly associated with anticipated impacts.
- The Washington Department of Fish and Wildlife has the authority under the hydraulics code to require mitigation for the protection of fish life.
- The U.S. Army Corps of Engineers has the authority to require mitigation of wetland impacts.
- Local agencies have the authority to require mitigation of wetland and stream impacts in accordance with their critical area ordinances.

5.1 Purpose of the Endangered Species Act

The purpose of the Endangered Species Act is to provide a means whereby the ecosystems upon which threatened and endangered species depend may be conserved, and to provide a program for the conservation of such species. Under Section 7(a)(1) of the ESA, federal agencies are directed to utilize their authorities in furtherance of the purpose of this act by carrying out programs for the conservation of listed species.

5.2 Federal Agencies and Washington State Department of Transportation Programs to Support the Recovery of Listed Species

The Washington State Department of Transportation supports a fish passage replacement program within the agency. Under this multimillion-dollar program, numerous fish passage barriers are replaced each year. Replacements are prioritized according to their level of benefit to fish. In 2002, WSDOT also established a collaborative process with Washington Department of Fish and Wildlife (WDFW) to address chronic environmental deficiencies (CED); locations along the state highway system where recent, frequent, and chronic maintenance and/or repairs to the state transportation infrastructure are causing impacts to fish and/or fish habitat. This program strives to develop long-term solutions for these problem areas. Additional information on both of these programs is available at:
<http://www.wsdot.wa.gov/environment/fishpass/default.htm#CED>.

WSDOT also has an active research program that has included a wide variety of topics including examining habitat connectivity on Snoqualmie Pass, evaluating the effects of ferry docks on fish migration, and establishing the fish passage requirements of juvenile salmonids. Additional information on the Environmental Research program is available at:
<http://www.wsdot.wa.gov/research/>.

FHWA has supported numerous studies, conferences, and projects focused on habitat connectivity, fish passage programs and standards, wetland restoration, and other environmental programs.

Neither agency supports recovering listed species on a project-by-project basis through Section 7 consultations.

5.3 The Section 7 Consultation Process

Under the Section 7 consultation process, the action agency is required to make an *effect determination*, that is, to determine the effect the project will have on a listed species. Section 7 requires action agencies to minimize the level of *take* associated with each project. There is no requirement that the action agency mitigate for incidental *take*. In this regard, ESA is different from other environmental regulations such as wetland regulations, which require mitigation for impacts.

However, the concepts of avoidance and minimization of impacts are important parts of project planning and implementation, playing a large role in the determination of effect. For example, if a project occurs during the sensitive nesting season and is out of sight of a spotted owl nest site or an occupied marbled murrelet nest stand but will use heavy equipment within 35 yards of the nest site or stand, the project will result in an adverse effect on the species and therefore will require formal consultation. The same is true for a project that will complete in-water work while listed fish species are present.

However, if the project is timed to occur outside the sensitive nesting season or the migration period when fish are likely to be present, the effect determination will be NLTAA. This effect call allows the project to undergo the shorter informal consultation process. In these examples, it may not be possible to have a no effect call because the owls tend to be present year round, murrelets may visit their nesting stand throughout the year, and both species may elect to alter their behaviors during the project.

Unfortunately, there are circumstances when an adverse effect call must be made and the project must undergo formal consultation. Examples include long-term projects (e.g., a bridge replacement) or weather-dependent projects that are unable to avoid the sensitive nesting period. This is often the case for projects that require in-water work in waters that contain rearing steelhead or chinook and where there is suitable rearing habitat in the project area. It is not possible to mitigate an adverse effect call down to a NLTAA call. If fish will be harassed by the in-water work or caught in nets and moved out of the work area, this meets the definition of *take*, and performing mitigation (such as replanting a riparian corridor or replacing a fish passage barrier) will not prevent fish from being harassed or harmed while being moved.

5.4 What the Services Can Require

When a proposed project is determined to have an adverse effect on listed species, the Services issue a biological opinion that may include reasonable and prudent measures that are mandatory and must be carried out by the action agency. These measures serve to minimize impacts on specific individuals or habitat affected by the action. The required measures should be developed in conjunction with the action agency and the applicant to ensure that they are reasonable, will result in only minor changes to the project, and are within the legal authority and jurisdiction of the agency to implement.

Reasonable and prudent measures may include narrowing the right-of-way to be disturbed, moving the location of temporary storage areas, or changing the scope, duration, and timing of the project.

Examples of unreasonable measures include asking a federal agency to implement a local county's riparian buffer protection ordinance, asking the applicant to make modifications to the property of another individual or agency, or asking the applicant to complete a research project on the life history and habitat utilization of a listed species.

5.5 Agencies with the Authority to Require Mitigation

The Washington Department of Fish and Wildlife has the authority under the hydraulics code to require mitigation for the protection of fish life. A hydraulic project approval (HPA) permit is required for work occurring within waters of the state. The habitat biologist issuing the permit determines what the mitigation will be, and it can include the correction of fish passage barriers, revegetation of stream banks disturbed during construction, or placement of large woody debris. If an HPA is required for a project, and mitigation is required as part of the HPA, then the mitigation becomes part of the project, and the impacts of the mitigation on listed species must be addressed in the BA.

In addition, local agencies can require mitigation for wetland and stream impacts in accordance with their critical areas ordinances. The U.S. Army Corps of Engineers also can require mitigation for wetland impacts. The mitigation becomes part of the project, and the effects of completing the mitigation must be addressed in the BA. The mitigation does not occur as a requirement of ESA; rather, it occurs as part of the project.

5.6 Mitigation Under the Endangered Species Act

Sometimes agencies add mitigation to a project because of suggestions by the Services that unless the mitigation is completed, the project will need to undergo formal consultation (which is a very long process). In some cases it may be appropriate to make the suggested changes to a project, but in many cases it is not. Examples of suitable suggested changes include altering project timing to avoid or minimize impacts on species, or revegetating a stream bank that was disturbed by construction. Examples of unsuitable suggested changes include purchasing a conservation easement on a mile of stream bank to keep a riparian corridor intact, completing research on a species, and using soft structure methods to control bank or bridge scour that will result in compromising the safety of the structure or the traveling public. The Services cannot require major changes to projects, and any suggested changes to projects should be directly associated with anticipated impacts of the project. The action agency must recognize that the consultation process, whether formal or informal, is based on the effect call for a project.

5.7 Why Action Agencies Should Help to Recover Listed Species

Agencies should do what they can to help recover listed species. While restoration and enhancement activities should not be performed as mitigation for Section 7 consultations, they should be implemented where possible as part of the project. For example, when a paving or safety improvement project crosses a stream with a culvert that is a documented fish passage barrier, that culvert should be replaced as part of the project. The rationale for completing the project this way is that the barrier needs to be removed, and while the replacement may be scheduled for a later date, it is easier to do it as part of the proposed project as the equipment is already in place, and the new pavement will not be compromised in the future. The project is submitted to the Services with the fish passage barrier replacement as part of the project, not as mitigation for the project.

6.0 Impact Avoidance and Minimization Measures

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Chapter Summary

- Performance standards are observable or measurable benchmarks for a particular performance objective against which a project can be compared. If the standards are met the related performance objectives are considered to have been fully achieved. Performance measures must be something quantifiable, measures not actions that are 1) achievable and 2) capable of being monitored. Performance standards may only be applied on some projects.

- Conservation measures are activities or measures that help recover listed species. Conservation measures may only be part of some projects.

- Minimization measures (MMs) are measures that reduce the impact of a project on listed species or habitats. Minimization measures can be precautionary measures implemented by the federal action agency to minimize or eliminate project effects on listed and sensitive species and habitat, or they can include avoidance and preservation measures such as timing restrictions or buffers around sensitive habitat types and habitat features that are important to sensitive species. Minimization measures apply to all projects.

- Best management practices (BMPs) are methods, facilities, built elements, and techniques implemented or installed during project construction to reduce short- and long-term project impacts on listed and sensitive species and habitat. BMPs are applied for all projects.

- Minimization measures and BMPs are measures that are considered part of the proposed action that will be implemented. They are not recommendations or suggestions.

- MMs and BMPs can be defined to minimize impacts associated with specific project activities or techniques.

- MMs and BMPs can be defined to minimize potential impacts on species and habitat.

- Examples of activity-specific measures include erosion control features for earthwork activities, replanting of areas where vegetation removal or grading has occurred, infiltration features for stormwater runoff in projects adding new impervious surface area, and mitigation plans for wetland impacts.

- Examples of habitat- or species-specific measures include timing restrictions, exclusion of listed species from the work area, noise shields, and avoiding riparian vegetation removal.
- MMs and BMPs should be compiled into the Impact Avoidance and Minimization section of the BA. This section should include MMs and BMPS addressing specific construction elements, as well as impact minimization measures for particular species and critical or suitable habitats.
- MMs and BMPs that are consistent with WSDOT standard specifications can be easily incorporated into project contract documents.
- MMs and BMPs that are not consistent with WSDOT standard specifications must be incorporated as special provisions into contract documents. The project biologist should coordinate with project designers and engineers to ensure that these additional provisions are feasible. The project biologist should work with project designers to ensure that special provisions are incorporated into contract documents.

This chapter defines and explains minimization measures (MMs) and best management practices (BMPs) and explains where to discuss them within a BA. The chapter provides an overview of common construction activities for which impact minimization measures may be required, general considerations for developing appropriate impact minimization measures for construction activities, guidance for developing impact minimization measures for sensitive species and habitats, and examples of appropriate enforceable wording for MMs and BMPs extracted from BAs.

The chapter is organized as follows:

- The first section of the chapter defines MMs and BMPs and discusses the differences between them.
- The second section explains where a project biologist should include discussions of MMs or BMPs within a BA, as well as two preferred options for compiling these impact minimization measures to facilitate federal review of the BA and also to facilitate incorporation of the required measures into the contracts administered for a project.
- The third section provides an overview of construction activities that may require impact minimization measures, followed by a more detailed discussion of three specific project activity types. This discussion outlines general considerations for assessing impacts and appropriate ways to minimize these impacts. The last subsection provides examples of MMs and BMPs that address in-water work impacts, and includes a BA excerpt

that illustrates how one project biologist defined specific project activities, associated impacts, and specific impact minimization measures.

- The fourth section discusses the importance of considering additional species- and habitat-specific impact minimization measures. The first subsection addresses MMs for particular species and illustrates, in a BA excerpt, the timing restrictions developed for one project. The second subsection addresses MMs and BMPs for minimizing impacts on sensitive habitats. Examples of specific M Ms and BMPs are provided for sensitive aquatic and terrestrial habitats.

6.1 Impact Minimization Measures and Best Management Practices

MMs and BMPs are precautionary measures intended to minimize environmental impacts associated with proposed project activities or elements. These measures can target impacts associated with specific project activities or techniques, as well as potential impacts on species and habitat. MMs and BMPs are not merely recommendations; they are measures included in the proposed action, to be implemented throughout project planning, design, and construction in order to minimize environmental impacts. The Services cannot consult on recommendations, only known project elements or measures that will be implemented.

MMs are most frequently avoidance or preservation measures of some kind, for example, timing restrictions or buffers around sensitive habitat types and habitat features that are important to sensitive species. BMPs are methods, facilities, built elements, and techniques implemented or installed during project construction to reduce short- and long-term project impacts. The nature of MMs and BMPs vary according to physical and environmental conditions of the project site, different phases of the project, and the activities for which they are intended. MMs and BMPs are developed for implementation during the permitting, design, and construction phases of projects.

Typically, the BA is developed concurrently with the design of a new project. During this process, it is critical for the biologist writing the BA and engineers designing the project to stay in close communication throughout preliminary and final design. The project biologist relies on the design engineers for accurate project description detail (e.g., project areas and construction techniques). Based on this information, it is the biologist’s responsibility to identify MMs and BMPs for the project in conjunction with the design and project engineers. The project engineer must approve all of the MMs and BMPS to ensure that the MMs and BMPs can be implemented and are included in the contract.

MMs and BMPs are effective only if they are clearly communicated to the contractor responsible for construction of the project. To construct a project, the contractor relies entirely on the construction plan sheets, WSDOT *Standard Specifications for Road, Bridge, and Municipal Construction* (WSDOT 2004a), and supplemental special provisions. Some MMs and BMPs are partially or wholly covered in the standard specifications, but many are not and need to be incorporated by the design engineers into the construction plan sheets and the special provisions. Some MMs are conditions attached to permits, such as a Clean Water Act Section 404 permit, a Section 401 water quality certification, or a hydraulic project approval. All permits must be attached to the construction plans and referred to in the special provisions so that the contractor is familiar with them. To the extent possible, these permit conditions should be specified in the special provisions.

After the BA receives concurrence from the Services, all MMs and BMPs need to be finalized in the construction plans and special provisions. After final design, the construction plans and special provisions are advertised so that contractors can bid on the project. The contractor selected for the project is responsible to carry out only what is specified in construction plans, standard specifications, and special provisions. For this reason, it is critical that all necessary MMs and BMPs are clearly described in the BA. If they are missing or unclear, there is a risk that the contractor may perform activities that harass threatened or endangered species, damage critical habitat, or damage suitable habitat for listed species.

The following sections of this chapter contain many examples of MMs and BMPs that have been used on projects in the past and are currently used for projects that comply with the *Programmatic Biological Assessment for the Washington State Department of Transportation Eastern Washington Regions – Working Document* (WSDOT 2004b), and the *No Effect and Not Likely to Adversely Affect Programmatic Biological Assessment Working Document for NOAA Fisheries Listed Species* (WSDOT 2002).

6.2 Where to Include Minimization Measures and Best Management Practices within a BA

MMs and BMPs should be compiled into a single section of the BA that includes measures addressing specific construction elements as well as impact minimization measures for particular species and critical or suitable habitats. Activity-specific measures are usually defined first in the BA development process, then species- or habitat-specific measures are defined later.

If the general term *BMPs* is used in a BA, the specific impact-minimization activities intended by the project biologist in using this term should be described in the report, so that the Services understand the exact measures that will be taken to reduce potential project impacts. For example, if a BA states, “during construction, BMPs will be implemented to ensure that impacts on the adjacent stream are minimized,” the project biologist should describe these practices in detail (e.g., all disturbed areas will be replanted or reseeded within 30 days).

Because impact minimization measures can be included in two distinct sections of a BA, it is important to compile all of these measures in a single location, for two reasons: 1) to facilitate review of the final effect determinations and their rationale, and 2) to ensure that all measures identified in a BA are clearly specified in documents conveyed to the contractor implementing the project. A compilation of impact minimization measures can be effectively provided in a list of all impact minimization measures identified in the report (activity-specific, as well as species- or habitat-specific), to be included in the Impact Avoidance and Minimization Measures section of the BA.

6.3 Developing Appropriate Impact Minimization Measures for Specific Construction Activities

6.3.1 Overview of Common Construction Activities

Some of the most common activities associated with construction and operation of transportation projects include the following:

- Grading, cutting, or filling
- Vegetation removal or clearing
- In-water work activities
- Highway runoff treatment
- Activities that increase the timing and duration of noise above ambient levels (e.g., pile driving and blasting)
- Sediment removal
- Road, bypass, or interchange construction and maintenance
- Pavement patching, repair, painting, and crack sealing
- Sweeping or cleaning
- Guardrail installation
- Slope repair
- Shoulder widening
- Roadside landscaping
- Ditch or channel maintenance
- Wetland mitigation
- Riparian revegetation or restoration
- Culvert and inlet repair, replacement, extension, or installation
- Stream bank stabilization

- Bridge removal and construction, structural bridge repair, and scour repair
- Debris removal or relocation
- Bioswale construction.

6.3.2 General Considerations for Minimizing Activity-Specific Impacts

Two of the most common transportation-related construction activities listed above are discussed below in more detail (grading, cutting, or filling; and vegetation removal). These examples illustrate types of impacts and general impact minimization approaches a project biologist might consider in selecting specific MMs and BMPs for the proposed project. A similar list of impacts and general impact-minimizing measures or practices could be developed for any of the specific activities listed above.

6.3.2.1 Grading, Cutting, or Filling

To adequately address earthwork activities (grading, cutting, and filling) in a BA, the extent of these activities should be quantified. Specific details should be provided regarding the size and type of fill to be placed, the location of fill in relation to nearby water resources, the methods and locations of soil removal and disposal, and methods of soil stabilization after grading or filling is complete. The placement of fill or the disturbance soils within areas containing salmon-bearing streams can have several impacts, including but not limited to the following:

- Introduction of additional impervious or semi-impervious surface area to the riparian system
- Introduction of additional potentially erodable materials to the system
- Alteration of hydrodynamics within the system
- Suspension of sediments in nearby water bodies.

Some examples of general approaches that might be considered to minimize impacts associated with projects requiring grading and filling activities include but are not limited to the following:

- Placement of a no-construction buffer around wetlands and sensitive riparian habitats
- Avoidance of grading or placement of fill adjacent to fish-bearing streams or wetlands
- Straw placement, hydroseeding, or planting of newly disturbed sites to minimize erosion
- Placement of erosion control features (e.g., hay bales or silt fences) surrounding newly disturbed or filled sites.

The following examples of MMs developed for projects requiring filling illustrate how to word MMs appropriately:

MM 1. Fill material shall be placed, not randomly dumped.

The intent of this MM is to minimize impacts on sensitive fish habitat within streams and rivers associated with placement of rock for filling scour holes or making barbs. To ensure that rock is carefully placed in streams and rivers, the design should incorporate language similar to the following within the site work sections of the special provisions: Contractor will place rock by hand or employ machine placement in areas designated in the drawings.

MM 2. Temporary fills must be entirely removed and the site restored to preexisting conditions.

The intent of this MM is to ensure that temporary fills are removed and the site is restored so that potential impacts on sensitive areas (such as erosion and sedimentation, changes in drainage paths, compaction, settlement, etc.) are not permanent.

This MM is not specifically addressed in the standard specifications and should be incorporated into construction plans and special provisions. For example, if a temporary access road is placed in a wetland, instructions should be provided for the contractor to remove all road materials and restore the area (i.e., restore soils and native vegetation).

If soil compaction is an issue, the contractor could be required to decompact affected areas by ripping to a depth of at least 12 inches, regrading, and recompacting to a specified maximum density. This is most important where the work includes plantings, because root growth is inhibited by densely compacted soils. To define acceptable levels of density and compaction limits, it is prudent to obtain a sample of the site soils and perform laboratory testing to determine the moisture-density relationship. Otherwise, a conservative specification for the compaction limit is 85 percent of the soil's maximum dry density as determined by test method ASTM D698.

6.3.2.2 Vegetation Removal and Clearing

To adequately address vegetation removal or clearing activities, the BA should quantify the extent of vegetation removal and clearing activities proposed for each phase of the project, or for the project as a whole. The trees to be removed as part of a project also should be quantified in terms of acreage or number of trees, and described by species and diameter-at-breast-height (dbh) class, if possible. If riparian vegetation is removed as part of the proposed action, the amount and type of riparian vegetation to be removed should be measured, and its stream shading, bank stabilization, and food web contribution functions should be assessed. For wetland vegetation to be removed, the area should be quantified, and the ecological functions (as they relate to listed species) lost as a result should be considered in the assessment of project impacts.

The general impacts associated with vegetation removal or clearing activities include but are not limited to the following:

- Removal of trees (indicate whether they are suitable or unsuitable habitat)
- Removal of riparian vegetation
- Wetland impacts
- Introduction of noxious weeds or exotic species
- Ground or soil disturbance or compaction
- Increased bank or soil erosion
- Sedimentation
- Noise impacts
- Human presence or activity impacts
- Impacts on prey species.

Some general approaches that the project biologist might consider to minimize impacts associated with these activities include the following:

- Where riparian vegetation has been removed from aquatic resources, isolate disturbed areas using erosion control features (such as silt fencing or hay bales) until disturbed areas are stabilized or revegetated
- Replant areas with native vegetation, or hydroseed disturbed sites, to prevent soil erosion
- Cut vegetation at the ground surface rather than grubbing, which removes the roots.

The following examples of MMs developed for projects requiring vegetation removal illustrate how to word MMs appropriately:

MM 3. Boundaries of clearing limits associated with site access and construction limits will be flagged to prevent ground disturbance outside the limits.

The intent of this MM is to confine work activities to nonsensitive areas, or minimize the amount of disturbance in sensitive areas.

There is language within the standard specifications that covers this in general.[1] *However, the drawings still must clearly depict the areas to be protected. If it is critical, the drawings and special provisions should include a requirement for the contractor to delineate these areas using temporary high-visibility fencing.*

To ensure that unintended disturbance does not occur in sensitive areas, the design should incorporate language similar to the following within the site work sections of the special provisions: "Contractor will install temporary high-visibility fencing to demarcate and protect sensitive areas. No work, including placement or stockpiling of fill materials, will be performed within these areas. When it is no longer needed, or at the engineer's direction, contractor will completely remove and dispose of temporary high-visibility fencing."

The sensitive areas should also be delineated on the drawings, along with a note containing a similar statement regarding installation of high-visibility fencing and the need to protect these areas.

Because the standard specifications do not include installation or material requirements for temporary high-visibility fencing, the designer should include provisions for temporary high-visibility fencing installation and materials.

MM 4. Vegetation will be grubbed only from areas undergoing permanent alteration. No grubbing will occur in areas slated for temporary clearing followed by revegetation.

The intent of this MM is to minimize disturbance and to allow vegetation to grow back in temporary impact areas.

See comment for MM 3.[2]

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1. Section 1-07.16 of the standard specifications – *Protection and Restoration of Property*: *The contractor shall protect private or public property on or in the vicinity of the work site. The contractor shall ensure that it is not removed, damaged, destroyed, or prevented from being used unless the contract so specifies. . . . If the engineer requests in writing, or if otherwise necessary, the contractor shall install protection, acceptable to the engineer, for property (land, utilities, trees, landscaping, … and other property of all description whether shown on the plans or not)*.

Section 1-07.16(2) – *Vegetation Protection and Restoration: Existing vegetation, where shown in the plans or designated by the engineer, shall be saved and protected through the life of the contract. The engineer will designate the vegetation to be saved and protected by a site preservation line and/or individual flagging.*

In Section 2-01.1, the areas to be cleared and grubbed are limited by the following statement: *The contractor shall clear, grub, and clean up those areas staked or described in the special provisions. This work includes protecting from harm all trees, bushes, shrubs, and other objects to remain.*

Section 2-01.3(1) – *Clearing: The contractor shall protect, by fencing if necessary, all trees or native growth from any damage caused by construction operations*.

2. Section 2-01.3(2) of the standard specifications – *Grubbing: The contractor shall grub all areas indicated by the engineer or by the special provisions.*

MM 5. Disturbed areas will be restored to pre-project conditions, using native plant species that are endemic to the project vicinity or region.

The intent of this MM is to ensure that areas temporarily disturbed are adequately restored.

For areas that are designated to not be disturbed, their restoration is covered in the standard specifications.[3] *These areas should be specifically delineated on the drawings (see above comments). However, for areas disturbed in the course of the work, this MM is not specifically addressed in the standard specifications. The construction drawings and special provisions should incorporate appropriate restoration requirements for each disturbed area. This may include a planting plan that identifies each location and native plant species to be planted in disturbed or temporary impact areas.*

To ensure that plants successfully mature, a monitoring and maintenance plan should be implemented after construction. The standard specifications have a requirement for plant establishment.[4] *However, if desired, the designer should incorporate any critical or special procedures, as required by permit conditions, for monitoring after construction, submitting monitoring reports to permitting agencies, and implementing maintenance measures, as necessary.*

MM 6. Removal of riparian vegetation will be minimized to the greatest extent possible. Native riparian vegetation will be replanted where feasible. Vegetation restoration will be coordinated with [insert the appropriate agency name].

The intent of this MM is to minimize impacts on riparian areas.

This MM is addressed in the previously noted sections of the standard specifications, but without specific reference to riparian habitat. Although the standards list WDFW requirements for replanting stream bank or shoreline plants that are disturbed,[5] *the requirement to minimize impacts on riparian areas is not specifically addressed in the standard specifications.*

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3. Section 1-07.16(1), 4th paragraph: *If the contractor (or agents/employees of the contractor) damage, destroy, or interfere with the use of such property, the contractor shall restore it to original condition.*

4. Section 8-02.3(13) – *Plant Establishment*: *Plant establishment shall consist of caring for all plants planted on the project and caring for the planting areas within the project limits.* This section also requires that the contractor prepare and submit a *first year plant establishment plan* for approval.

5. Section 1-07.5(2) of the standard specifications – *State Department of Fish and Wildlife: The contractor shall replant any stream bank or shoreline area if the project disturbs vegetative cover. Replanted trees, brush, or grasses shall resemble the type and density of surrounding growth, unless the special provisions permit otherwise.*

This MM should be incorporated into the construction plans and special provisions by clearly designating where vegetation will be preserved (see MM 3) in riparian areas. In addition, this MM should be incorporated into the planting plans by designating the locations and species of native plants to be planted in riparian areas.

6.3.3 In-Water Work: Impact Minimization Approaches and BA Excerpt

6.3.3.1 General Considerations for In-Water Work

In-water work activities include but are not limited to pile installation, bank stabilization, pile removal, bridgework, stream or ditch realignment work, and culvert replacement. The construction methods or techniques employed in each of these activities have impacts that are unique to their application. Common impacts include sedimentation, impacts on substrate (spawning beds and cover), and direct mortality of fish.

In-water work methods and their impacts should be carefully researched and described by the project biologist. A BA should document the specific construction techniques, materials, and impacts of the proposed action in relation to the listed species and habitats occurring in the project action area. To minimize these impacts, MMs tailored to the construction methods must be developed and included in the BA. This topic is discussed more completely in PART 2, IN-WATER WORK.

General approaches that should be considered by the project biologist to minimize impacts of in-water activities include but are not limited to the following:

- Avoid in-water work if feasible, or conduct it only during approved in-water work windows.
- Divert streamflow during in-water work to minimize turbidity.
- Use bioengineered solutions where feasible.
- Perform work during low flow or dry conditions, or during dry weather.
- Isolate the area of in-water work from the water body to minimize sediment impacts (using cofferdams, silt fencing, hay bales, or water sausages), and pump sediment-laden waters to an infiltration or treatment site.
- Isolate the work area to avoid impacts on listed fish species, and remove fish from the area if necessary (using seining, netting, and as a last resort, electrofishing). WSDOT now has a fish handling protocol that has been approved by NOAA Fisheries (USFWS approval is still pending).
- Dispose of debris or sediments outside the floodplain.

- Clean the activity site after construction to prevent an influx of sediments to streams after the first large storm event.
- Minimize impacts on stream banks and riparian vegetation.

6.3.3.2 Examples of MMs and BMPs: In-Water Work

The following examples of MMs and BMPs developed for projects requiring in-water work illustrate how to word MMs or BMPs appropriately:

MM 7. Work below the ordinary high water mark (OHWM) will be conducted during the in-water work window listed in the hydraulic project approval (HPA) issued by WDFW and approved by USFWS and NOAA Fisheries.

The intent of this MM is to avoid impacts on fish when they are most likely to be present in a natural water body where work is proposed.

This particular MM is covered in a very general way by the standard specifications.[6]

Seasonal restrictions on work in water bodies are rules that WDFW adds as conditions in HPAs. These seasonal restrictions need to be incorporated into the special provisions.

MM 8. Either the in-water work area will be isolated from the rest of the water body and surrounding riparian areas, or flows will be diverted around the area of construction using appropriate features (e.g., filtration fencing, water sausages, or cofferdams).

The intent of this MM is to avoid or minimize turbidity impacts on fish and habitat downstream of the construction area.

The standard specifications have provisions that cover the intent of this MM.[7] *The designer should review these requirements and augment as necessary within the special provisions.*

MM 9. Work will not inhibit passage of any adult or juvenile salmonid species throughout the construction period or after project completion.

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6. Section 1-07.5(1) of the standard specifications – *General – Fish and Wildlife and Ecology Regulations: Throughout the work, the contractor shall comply with all current rules of the state Departments of Fish and Wildlife, and Ecology.*

7. Section 1-07.5(2) of the standard specifications – *State Department of Fish and Wildlife: The contractor shall never block stream flow or fish passage.*

Section 2-09.3(3)A – *Preservation of Channel*: *When foundations or substructures are built in or next to running streams, the contractor shall excavate inside cofferdams, caissons, or sheet piling unless dredging or open pit excavation is permitted. Contractor shall never disturb the natural stream bed next to structure.*

The intent of this MM is to avoid interfering with the migration and rearing activities of salmonids.

Because the standard specifications do not allow for blocked fish passage, an HPA permit is necessary to override this specification. Conditions of the HPA should be referenced in the special provisions.

MM 10. All concrete will be poured in the dry, or within confined waters not connected to surface waters, and will be allowed to cure a minimum of 7 days before contact with surface water.

The intent of this MM is to prevent concrete from increasing the pH of natural water bodies by allowing concrete to fully cure prior to contact with water.

The standard specifications cover placement and curing of concrete from a quality control standpoint rather than an environmental protection standpoint.[8] *However, there is a provision that prohibits discharge to the environment of water used for curing.*[9]

The standard specifications do not indicate the minimum time necessary before concrete can contact surface water. This information should be added to the special provisions. For additional protection, the designer should consider requirements for rinsing the freshly cured concrete prior to allowing it come into contact with surface waters.

MM 11. Sediment-laden water generated during construction will be pumped to an infiltration site or to an upland settling area, where it is subsequently treated and sediments are consolidated prior to returning water to streams. Sediments will then be removed and disposed of in accordance within Washington Department of Ecology requirements. Discharge of water back to streams will occur in such a manner as not to cause erosion.

The intent of this MM is to protect streams from turbidity impacts associated with sediment-laden runoff.

The standard specifications generally prevent the discharge into state waters of any material that contains sediment.[10] *Additional specific*

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8. Section 6-02.3(6) – *Placing Concrete*: *When a foundation excavation contains water, the contractor shall pump it dry before placing concrete. If this is impossible, an underwater concrete seal shall be placed that complies with Section 6-02.3(6) B.*

9. Section 6-02.3(11) – *Curing Concrete*: *Concrete shall cure for a minimum of 3 days and as long as 14 days depending on the type of concrete and curing method. Water used to cure the concrete shall not be allowed to run off and enter any lakes, streams, or other surface waters*.

10. Section 1-07.5(3)4 of the standard specifications: *Dispose of, in ways that will prevent their entry into state waters, all toxicants (creosote, oil, cement, concrete, and equipment wash water) and debris, overburden, and other waste materials*.

requirements for water pollution control are found in Section 8-01 Erosion Control and Water Pollution Control.[11] *Ground water encountered within excavations shall be treated before being discharged.*[12]

Otherwise, this MM is not specifically addressed in the standard specifications. If a project site has a viable upland area for treatment or infiltration, this MM should be incorporated into the special provisions and design drawings as an option. The designer should also pay attention to the physical nature of the sediment/turbidity to determine the feasibility of settlement as a treatment method. The contractor also may prefer to use other treatment methods.

MM 12. All culvert replacements and fishways will be designed in accordance with the WDFW *Fish Passage Design at Road Culverts: A Design Manual for Fish Passage at Road Crossings* (WDFW 1999) and *Fishway Design Guidelines* (WDFW 1992).

The intent of this MM is to provide culverts that are fish-passable during all seasons of the year.

Typically, culvert design is performed by the designer and fully incorporated into the contract drawings and special provisions, in which case this MM does not pertain to the contractor. In the case of temporary culverts installed for diversions or other purposes, the design may or may not be performed by the contractor. If the contractor performs culvert design, this MM should be incorporated into construction plans and special provisions and approved by WDFW in the HPA permit.

MM 13. Prior to entering the water, all equipment will be checked for leaks and completely cleaned of any external petroleum products, hydraulic fluid,

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11. Section 8-01.3(1): *Controlling pollution, erosion, runoff, and related damage requires the contractor to perform temporary work items including but not limited to 1) providing ditches, berms, culverts, and other measures to control surface water; 2) building dams, settling basins, energy dissipaters, and other measures, to control downstream flows; 3) controlling underground water found during construction; or 4) covering or otherwise protecting slopes until permanent erosion-control measures are working*.

12. Section 8-01.3(1) C: *When ground water is encountered in an excavation, it shall be treated and discharged as follows:*
1) When the ground water meets state water quality standards, it may bypass detention and treatment facilities and be rerouted directly to its normal discharge point at a rate and method that will not cause erosion.
2) When the turbidity of the ground water is similar to the turbidity of the site runoff, the ground water may be treated using the same detention and treatment facilities being used to treat the site runoff, and then discharged at a rate that will not cause erosion.
3) When the turbidity is worse than the turbidity of the site runoff, the ground water shall be treated separately until the turbidity is similar to or better than the site runoff before the two may be combined and treated, using the same detention and treatment facilities being used to treat the site runoff, and then discharged at a rate that will not cause erosion.

coolants, and other deleterious materials. Washwater will not be discharged to any water body without pretreatment to state water quality standards.

The intent of this MM is to prevent pollutants from entering natural water bodies and affecting fish or habitat.

The standard specifications provide general requirements to prevent pollutants from entering state waters,[13] *along with two specific requirements for keeping equipment out of state waters*[14] *and preventing the discharge of equipment washwater into state waters.*[15]

However, if in-water work is to be conducted, the special provisions should be augmented to require that the contractor inspect equipment for leaks and faulty parts (especially hydraulic lines, fittings, and cylinders) and clean the equipment each day or shift that the equipment is to enter the water. Additionally, the designer should add language to the special provisions to require that all equipment operating in state waters contain biodegradable, nontoxic, vegetable-based hydraulic oil rather than petroleum-based hydraulic oil.

MM 14. All equipment entering waters containing bull trout will use vegetable oil or other biodegradable, acceptable hydraulic fluid substitute.

The intent of this MM is to prevent hydraulic fluid spilling into and polluting natural water bodies in the event of an accidental release due to equipment leakage or hydraulic component failure.

This MM is not addressed in the standard specifications and should be incorporated into construction plans and special provisions (see comments under MM 13).

MM 15. Culvert cleaning and repair will occur in the dry or when listed or proposed fish are not likely to be present.

The intent of this MM is to avoid disturbance to fish in the vicinity of culverts during cleaning and repair activities.

Culvert cleaning MMs are not addressed in the standard specifications. If culvert cleaning is included in a contract, this MM language should be incorporated into the special provisions.

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13. Section 1-07.5(2) of the standard specifications – *State Department of Fish and Wildlife: The contractor shall not degrade water in a way that would harm fish. (Criteria: Washington state water quality regulations.)*

14. Section 1-07.5(2)7: *Keep all equipment out of any flowing stream or other body of water, except as may be permitted by the special provisions.*

15. Section 1-07.5(3) – *State Department of Ecology*: *In doing the work, the contractor shall … dispose of, in ways that will prevent their entry into state waters, all … equipment wash water….*

MM 16. Every effort will be made to perform culvert cleaning activities from the top of the bank.

The intent and implementation of this MM is similar to MM 15. This MM is not addressed in the standard specifications and should be included in the special provisions as necessary (see the comments under MMs 13, 14, and 15).

MM 17. Every effort will be made to install riprap and other materials from the banks or outside the wetted perimeter.

The intent of this MM is to minimize disturbance to fish and habitat within natural water bodies.

This MM is not addressed in the standard specifications and should be incorporated into construction plans and special provisions, as necessary.

MM 18. All materials (such as riprap) placed within the water will be prewashed to remove sediment and other contaminants.

The intent of this MM is to prevent pollutants from entering natural water bodies and affecting fish or habitat.

This MM is not addressed in the standard specifications and should be incorporated into construction plans and special provisions.

MM 19. All dredged or excavated materials will be removed to an upland location where they cannot enter any water body.

The intent of this MM is to prevent pollutants such as sediments or contaminated sediments from entering water bodies and affecting fish or habitat.

The standard specifications have a few requirements that may meet the intent of this MM,[16] *although the specific location of upland disposal is not covered. Specific details related to this MM should be incorporated into construction plans and special provisions.*

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16. Section 1-07.5(2) of the standard specifications – *State Department of Fish and Wildlife*: *The contractor shall dispose of any project debris by removal, burning, or placement above high-water flows.*

Section 1-07.5(3) – *State Department of Ecology*: *In doing the work, the contractor shall … dispose of, in ways that will prevent their entry into state waters, all … debris, overburden, and other waste materials.*

Section 2-09.3(3)A – *Preservation of Channel*: *When foundations or substructures are to be built in or next to running streams, the contractor shall … remove any excavation material that may have been deposited in or near the stream so that the stream bed is free from obstruction.*

MM 20. Construction barges will not be beached.

The intent of this MM is to prevent barge-related impacts on beach substrates and vegetation.

While the standard specifications require the contractor to submit a plan detailing barge locations used for some activities,[17] this does not fulfill the intent of this MM. Therefore this MM should be incorporated into the special provisions.

MM 21. Construction barges will not be anchored in or above eelgrass or kelp beds, and drill rigs will not operate in or above eelgrass or kelp beds.

The intent of this MM is to prevent damage to eelgrass and kelp beds as a result of shading or disturbance by anchors or drilling equipment.

Because the intent of this MM is not covered by the standard specifications, this measure should be incorporated into the special provisions. All known locations of eelgrass and kelp beds should be delineated on the drawings with a reference note incorporating this MM.

6.3.3.3 Example of BA Section: In-Water Work

An example is provided below to illustrate an effective description of the construction process and identification of specific activity-related MMs and BMPs to address associated impacts.

Timber and Dolphin Wingwall Removal

Process

The dolphins at the Red Island ferry terminal are constructed of up to 100 piles each. The majority of the piles are creosote-treated timber, but some of the piles installed in recent years are plastic-coated steel or steel piles. Some of the timber piles are broken at the mud line, some are severely damaged by marine boring organisms, and others are in relatively good condition.

To remove existing dolphins, the tops of the dolphins will be unfastened and lashing or other connections between the timber piles will be removed. A vibratory hammer or a choker cable will be used to lift the broken piles from the sediment. After the first few piles associated with the dolphin are removed, the remaining piles come out of the sediment with ease, because pressure and suction on the piles has been alleviated.

The dogleg wingwalls can be removed by either of two methods. Either the above-water portion of the wingwall is dismantled and the piles are removed using a vibratory hammer/extractor, or the piles are cut off above the water line during a low tide and the above-water portion of the wingwall is removed in one

17. Section 6-02.3(25)N – *Prestressed Concrete Girder Erection,* and Section 6-03.3(7)A – *Erection Methods: The contractor shall submit a plan that shows location of barges.*

piece. Using the latter method, above-water sections of the wingwall come out in one piece and are taken upland and dismantled, reducing the amount of in-water work and the potential loss of associated debris into the water. The remaining pile stubs are removed with a clamshell bucket. The clamshell bucket replaces the hammer on the derrick, and the pile is grabbed and slowly pulled up. A small clamshell bucket is used to minimize disturbance to bottom sediments.

The method selected to remove wingwalls depends upon the condition of the wingwalls and favorable tides at the time of demolition. During pile removal, the removed piles are set to the side of the barge until pile removal is complete. Pulled timber piles either float horizontally on the water, or if they are heavily waterlogged, they are set vertically along the side of the barge. After all piles have been pulled, the piles are lifted onto the barge with a choker cable. Broken pile stubs and associated sediments (if any) are loaded onto a temporary storage area on the barge.

The temporary storage area will be lined with an erosion control blanket, filter fabric, or straw bales placed around the perimeter to separate sediments from runoff from the barge. Any water from either extraction method will be filtered through the sediment containment material on the barge before reentering Puget Sound, in compliance with WAC 173-201(A)-100 and the *Washington Departments of Ecology and Transportation implementing Agreement regarding Surface Water Quality Standards*.

Impact Minimization Measures

Impact minimization measures to be employed during pile removal include:

- All creosoted material and pile stubs will be disposed of by the contractor in a landfill that meets the liner and leachate standards of the Solid Waste Handling Standards, WAC 13-350. The contractor will provide disposal receipts to the project engineer.[18]

- Piles that break below the water line will be removed with a clamshell bucket. The size of the clamshell will not exceed 3.5 cubic yards, to minimize disturbance to bottom sediments.[19]

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18. *The intent of this MM is to ensure that removed pile material and sediments do not re-enter and contaminate a water body. This MM is partially addressed in the standard specifications for Structure Excavation, Class A, and the citations of the state Department of Ecology regulations (see MM 19 and footnote 10). The disposal of materials is primarily covered under Section 2-01.2 – Disposal of Usable Material and Debris. However, this MM should be incorporated into construction plans and special provisions.*

19. *The intent of this MM is to minimize disturbance of sediments surrounding piles. While removal of foundations is covered in the standard specifications, removal of piling is not. This MM should be incorporated into the construction plans and special provisions. The designer should verify that the maximum clamshell bucket size is appropriate for the size of piling to be removed.*

Section 2-02.3(2) of the standard specifications – *Removal of Bridges, Box Culverts, and other Drainage Structures*: *The contractor shall remove foundations of existing structures to a point 2 feet below the finished ground elevation, the adjacent ground elevation, or the natural stream bottom. If a foundation lies wholly or partially on the site of a new structure, it shall be removed to a level that accommodates building the new structure*.

- Piles, stubs, and associated sediments (if any) will be contained on a barge. The storage area will consist of a row of hay or straw bales, or filter fabric, placed around the perimeter of the barge. The arrangement of the containment area must meet the approval of the project engineer.[20]

- An oil containment boom will be employed during creosote piling removal. The boom will also serve to collect any floating debris from pile removal. Oil absorbent materials will be employed if visible product is observed. The boom will remain in place until all oily material and floating debris have been collected and sheens have dissipated.[21]

6.4 Developing Appropriate Impact Minimization Measures for Sensitive Species and Habitats

The listed species and habitats present in the vicinity of a project also determine the specific impact minimization measures to be implemented. Frequently, habitat- or species-specific conditions (e.g., restrictions on distance of construction from streams, stream crossing measures, timing restrictions, or noise shields) must be established to support the effect determination for the habitat or species.

The following sections provide explanations of MMs and BMPs developed for sensitive species and also for sensitive habitats. In addition, an example of timing restrictions is provided in a BA writing sample. Compiled lists of common MMs and BMPs illustrate impact minimization measures for selected sensitive habitats.

6.4.1 Impact Minimization Measures for Sensitive Species

If a sensitive species is present or could occur within the project action area, a project biologist may define measures and practices to avoid or minimize project impacts. Two of the most common measures defined to protect sensitive species and ensure given effect determinations are 1) timing restrictions, or 2) excluding or removing the species of concern from the area where impacts are anticipated.

Consider the following project example: Bald eagles are nesting in the vicinity of a paving project that has an action area confined to the developed portion of a roadway. A portion of the

20. *The intent of this MM is to require that dredged materials and piling demolition debris be stockpiled on a barge fitted with BMPs to control associated turbid water and sediments and prevent them from discharge into state waters. The very specific requirements of this MM are covered only generally by the standard specifications (see this MM). Therefore, these requirements should be incorporated into the special provisions and contract drawings.*

21. *The intent of this MM is to prevent oil associated with pilings from polluting surface waters in the vicinity of piling removal activities. Other than very general water pollution requirements, the intent of this MM is not adequately covered in the standard specifications. This MM should be incorporated into construction plans and special provisions, and should be made a requirement of the contractor's temporary erosion and sedimentation control (TESC) plan and/or spill prevention, containment, and control (SPCC) plan.*

project corridor is located within 400 meters of the nest and is in line-of-sight of the nest. The project is scheduled for construction during the breeding season (January 1 through August 15). It is likely that this project would adversely affect eagles due to noise and visual impacts. However, if the project biologist imposes timing restrictions on the project, stipulating that project activities should take place between August 15 and October 31 (outside the breeding and wintering seasons), the potential impacts would be reduced appreciably. In that case the project could receive a determination of *not likely to adversely affect* (NLTAA). Similarly, BMPs related to specific equipment or techniques might be required in order to minimize the construction-related noise associated with the project.

Where more than one listed species may be present, timing restrictions must be developed to accommodate the sensitive periods for all potentially affected species. Project biologists should always consult calendars showing sensitive periods for particular species to determine appropriate project timing.

Timing of construction in or near water bodies is dictated by the in-water work windows required in an HPA permit or by the area habitat biologist. NOAA Fisheries or USFWS may have different in-water work windows defined for different species and water bodies. Therefore, it is important to consult with WDFW and the Services to ensure that the proper in-water work window is cited. Calendars of sensitive periods for listed species are provided in PART 3, WILDLIFE SENSITIVE PERIODS CALENDAR.

If an incidental *take* permit is issued by the Services for a project, reasonable and prudent measures (RPMs) likely are stipulated by the Services. These specific measures must be incorporated into the contract to ensure that the project complies with the RPMs, and that impacts to the listed or proposed species are minimized to the greatest extent possible.

6.4.1.1 Example BA Section: Timing Restrictions

An example is provided below of overlapping timing restrictions for bald eagle and marbled murrelet habitats along a project corridor. Note that timing restrictions must be approved by the project office. If timing restrictions proposed by the project biologist are not feasible, formal consultation may be necessary.

- Summary timing restrictions from MP 0 to 12.
- Bald eagle breeding season, January 1 to August 15.
- Bald eagle wintering season, October 31 to March 31.
- Marbled murrelet breeding season, April 1 to September 15.
- 2 hours before sunset to 2 hours after sunrise: no construction from August 6 to September 15.
- Proposed project timing: 7/02 to 10/02 (45 working days).

No timing restrictions will be required along a total of 9.14 miles of the proposed project corridor. No restrictions will be required between the following mileposts:

- MP 0.00 to 1.62
- MP 2.46 to 3.19
- MP 5.21 to 12.00.

Timing restrictions will be required along the remaining portion of the project corridor. Table 6-1 lists the restrictions required to avoid eagle and murrelet impacts:

Table 6-1. Construction timing restrictions required to avoid impacts on eagles and marbled murrelets.

Mileposts	Timing Restrictions
MP 1.62 to 2.21	To avoid bald eagle nesting and breeding impacts: No construction January 1 to August 15. Construction allowed August 16 to January 1.
MP 1.66 to 2.46	To avoid marbled murrelet nesting and breeding impacts: No construction April 15 to August 5. Construction allowed August 6 to September 15 but must be confined to the period between 2 hours after sunrise and 2 hours prior to sunset. No restrictions September 16 to April 15.
MP 3.19 to 4.19	One nest in the vicinity of Rasmussen Creek was empty this year; therefore eagle timing restrictions are not necessary in this area for the 2001 construction season. The status of this nest will need to be reassessed for the 2002 construction season.
MP 4.19 to 5.21	To avoid bald eagle wintering impacts: No construction October 31 to March 31. Construction allowed April 1 to October 30.

The status of these nests and all of the nests along the project corridor should be verified to determine required timing restrictions for subsequent construction seasons.

Rationale: Timing restrictions are necessary due to presence of several bald eagle nests within 400 meters of the project area, three of which are in line of sight from roadway. Also, suitable marbled murrelet nesting habitat is present within 35 yards of the project area, and the project is adjacent to suitable murrelet foraging habitat. The project lies outside all listed fish ESU/DPSs.

As illustrated in Table 6-1, in some areas bald eagles and marbled murrelet restrictions overlap. To clarify the exact timing restrictions along the entire project corridor, a list summarizing the timing restrictions along SR 112 from MP 0.00 to MP 12 is provided below:

- MP 0.00 to 1.62: No timing restrictions.
- MP 1.62 to 1.66: No construction January 1 to August 15. Construction allowed August 16 to January 1.

- MP 1.66 to 2.21: No construction January 1 to August 15. Construction allowed August 16 to September 15 but must be confined to the period between 2 hours after sunrise and 2 hours prior to sunset. No restrictions September 16 to January 1.
- MP 2.21 to 2.46: No construction April 15 to August 5. Construction allowed August 6 to September 15 but must be confined to the period between 2 hours after sunrise and 2 hours prior to sunset. No restrictions September 16 to April 15.
- MP 2.46 to 4.19: No timing restrictions.
- MP 4.19 to 5.02: No construction October 31 to March 31. Construction allowed April 1 to October 30.
- MP 5.02 to 12.00: No timing restrictions.

6.4.1.2 Exclusion or Removal of Species of Concern from Project Area

Exclusion or removal of listed wildlife species from the vicinity of a project should always be conducted by a trained wildlife or fisheries biologist to ensure that the risk of injury to wildlife is minimized. Because handling listed wildlife or affecting its behavior by preventing access to its customary habitat could constitute a *take* under the Endangered Species Act, often the preferred option for reducing impacts on the species is to establish timing restrictions on construction.

The following example of a MM developed for projects requiring fish exclusion for in-water work illustrates how to word MMs or BMPs appropriately.

MM 22. All fish will be removed from the work area prior to any in-water work activities. Salmonid removal methods, listed in preferential order, are as follows: establishing a net enclosure around the work area, dispersal of salmonids through snorkeling, use of seine nets, dewatering of salmonid habitat, or netting of individuals. Electrofishing will be used as the last resort to remove any remaining fish.

The intent of this MM is to avoid stranding and potential mortality of fish within construction sites.

Although Section 1-07.5(2) of the standard specifications states that any stranded fish are to be released, it includes no requirements for specific fish removal methods. This MM should be incorporated into construction plans and special provisions.

6.4.2 Impact Minimization Measures for Habitats Associated with Sensitive Species

If a sensitive habitat type (e.g., designated critical habitat, suitable habitat, or aquatic resource) could potentially sustain impacts, a project biologist may need to define MMs and BMPs to minimize impacts on those habitat characteristics upon which listed species depend. The following section provides examples of MMs and BMPs that could be used to minimize impacts of proposed activities on sensitive aquatic and terrestrial habitats.

Properly worded MMs and BMPs use committing or obligatory language to emphasize that they are required conditions to be implemented during project construction.

6.4.2.1 Examples of MMs and BMPs: Sensitive Aquatic Habitat

Some common MMs and BMPs for transportation-related projects occurring near sensitive aquatic resources are provided below:

MM 23. Construction impacts will be confined to the minimum area necessary to complete the project.

The intent of this MM is to minimize impacts on the natural environment, including sensitive areas.

The standard specifications do not address this MM in the general manner stated above. This MM should be incorporated into construction plans and special provisions by clearly showing areas where no impacts are allowed (see MM 3).

MM 24. A spill prevention, control, and containment (SPCC) plan will be developed for the project to ensure that all pollutants and products are controlled and contained.

The intent of this MM is to prevent pollutants from entering natural water bodies.

The standard specifications require that an SPCC plan be developed,[22] *approved, and implemented throughout the duration of the project. The SPCC plan can be developed by the engineer for the contractor to adopt during construction, although normally the contractor is responsible for developing and implementing the plan.*

MM 25. No contractor staging areas will be allowed within 91 meters (300 feet) of any jurisdictional wetland, stream, river, or drainage as identified by the project biologist, unless site-specific review by the project biologist indicates that no impacts on sensitive resource areas will occur due to topography or other factors.

22. Section 1-07.15(1) of the standard specifications – *Spill Prevention and Countermeasures Plan*: *The contractor shall prepare a project specific spill prevention, control, and countermeasures (SPCC) plan to be used for the duration of the project. The plan shall identify staging, storage, maintenance, and refueling areas and their relationship to drainage pathways, waterways, and other sensitive areas. The plan shall identify spill prevention and containment methods to be used at each of these locations.*

The intent of this MM is to prevent materials from leaving the staging area and entering sensitive areas. For example, erosion of soil piles in staging areas could cause sediment-laden runoff to drain into sensitive areas. The distance specified may be project-specific.

This MM is not addressed in the standard specifications and should be incorporated into construction plans and special provisions.

MM 26. A temporary erosion and sedimentation control (TESC) plan and a source control plan will be developed and implemented for all projects requiring clearing, vegetation removal, grading, ditching, filling, embankment compaction, or excavation. The BMPs in these plans will be used to control sediments from all vegetation-disturbing or ground-disturbing activities.

The intent of this MM is to prevent or minimize drainage of sediment-laden water into sensitive areas.

The standard specifications have provisions for a TESC plan but do not make it mandatory.[23] *The designer has two options to ensure that a TESC plan is developed and implemented for the project: 1) the designer may develop a TESC plan in the special provisions and drawings, in which case the contractor is required by the standard specifications to either adopt or prepare an appropriate TESC plan, or 2) the designer may replace the first sentence in 8-01.3(1)A "Submittals" with the following: "The contractor shall prepare and submit a TESC plan for the engineer's approval."*

MM 27. For projects involving concrete pouring, concrete truck chute cleanout areas will be established to properly contain wet concrete and washwater.

The intent of this MM is to ensure that concrete construction activities occur in designated areas away from sensitive areas.[24]

Designated areas for concrete construction activities should be included in the SPCC plan.

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23. Section 8-01.3(1)A of the standard specifications – *Submittals – Erosion Control and Water Pollution Control*: *When a TESC plan is included in the project plans, the contractor shall either adopt or modify the existing TESC plan. The contractor shall obtain the engineer's approval on the TESC plan and schedule before any work begins.*

Section 1-07.15 – *Temporary Water Pollution/Erosion Control: The contractor shall perform all temporary water pollution and erosion control measures shown in the plans, specified in the special provisions, proposed by the contractor and approved by the engineer, or ordered by the engineer as work proceeds. In an effort to prevent, control, and stop water pollution and erosion within the project, thereby protecting the work, nearby land, streams, and other bodies of water, the contractor shall perform all work in strict accordance with all federal, state, and local laws and regulations governing waters of the state, as well as permits acquired for the project.*

24. Section 1-07.5(3) – *State Department of Ecology*: *The contractor shall dispose of all toxicants, including creosote, oil, cement, concrete, and equipment washwater, in ways that will prevent their entry into state waters.*

MM 28. Pressure-washing of concrete structures will be held to the minimum necessary to maintain structural integrity. Pressure-washing of concrete structures can result in an increased pH discharge with a potential to violate state water quality criteria.

The intent of this MM is to minimize concrete entering natural water bodies and having adverse effects on fish when preparing previously placed concrete surfaces to obtain proper bond to new concrete.

In addition to the standard specifications, the engineer should include specific requirements to contain, collect, and dispose of concrete washwater in the construction plans and special provisions (also see MM 27).

MM 29. The contractor will protect all inlets and catchments from fresh concrete, tackifier, paving, and paint stripping in case inclement weather unexpectedly occurs.

The intent of this MM is to prevent contaminated construction materials from entering inlets and catchments and being conveyed to natural water bodies or other sensitive areas.

The standard specifications cover this in general. However, it should be required on the TESC or SPCC plans.

MM 30. All exposed soils will be stabilized during the first available period and will not be allowed to sit idle for more than 7 days without receiving the erosion control treatment specified in the TESC plan. In the Puget Sound region, no soils will remain unstabilized for more than 2 days from October 1 to April 30 and for no more than 7 days from May 1 to September 30. Revegetation of construction easements and other areas will occur after the project is completed. All disturbed riparian vegetation will be replanted. Trees will be planted where consistent with highway safety standards. Riparian vegetation will be replanted with species native to that geographic region.

The intent of this MM is to minimize erosion of exposed soils and transport of sediment-laden water to sensitive areas.

The standard specifications cover this requirement with regard to the length of time allowed for exposed soils before stabilization is required.[25] *See MM 5 for information regarding replanting with native species.*

25. Section 8-01.3(1) of the standard specifications – *General – Erosion Control and Water Pollution Control*: *In western Washington, erodible soil not being worked, whether at final grade or not, shall be covered within the following time period, using an approved soil covering practice, unless authorized otherwise by the engineer: from October 1 through April 30, 2 days maximum; and from May 1 to September 30, 7 days maximum.*

MM 31. For all projects located within a listed fish evolutionarily significant unit (ESU) or DPS that involve 0.4 hectares or more (1 acre or more) of clearing, grading, or grubbing, a stormwater site plan will be developed and implemented. The stormwater site plan will include a spill prevention, control, and containment (SCC) plan, a temporary erosion and sedimentation control (TESC) plan, a hydraulic report, a BMP selection form, a water quality discipline report, and a BMP maintenance schedule.

The intent of this MM is to take extra precautions on large projects to prevent sediment-laden water and contaminants from entering natural water bodies and sensitive areas.

The standard specifications include measures for preparation of an SPCC plan (see MM 24) and TESC plan (see MMs 26 and 30). The standard specifications do not address a stormwater site plan, which should be developed by the engineer during the design phase and incorporated into the construction plans and special provisions.

MM 32. Projects will be designed in accordance with the WSDOT *Highway Runoff Manual* (HRM), or the local agency stormwater manual (if required by the local agency having jurisdiction) provided it is more stringent than the *Highway Runoff Manual*.

The intent of this MM is to ensure that stormwater-related impacts on natural water bodies and other sensitive areas are avoided and minimized by following WSDOT stormwater measures.

This MM is not addressed in the standard specifications and should be addressed during the design phase of the project, with necessary measures incorporated into the plans and special provisions.

MM 33. When practicable, all fueling and maintenance of equipment will occur more than 91 meters (300 feet) from the nearest wetland, ditch, or flowing or standing water. (Fueling large cranes, pile drivers, and drill rigs over 300 feet away may not be practicable.)

The intent of this MM is to prevent fuel and maintenance equipment spills from entering sensitive areas.

This MM is not specifically addressed in the standard specifications and should be incorporated into the SPCC plan, construction plans, and special provisions.

MM 34. Construction equipment will not enter any water body without authorization from WDFW, NOAA, or USFWS, as appropriate. Equipment will be operated as far from the water's edge as possible.

The intent of this MM is to minimize impacts (e.g., sedimentation) in natural water bodies by doing as much work as possible from beyond the water's edge.

See comments under MMs 13 and 14.

MM 35. Temporary material holding piles will not be placed in the 100-year floodplain during the rainy season (October through May) unless the following conditions are met: 1) storage does not occur when flooding is imminent, and 2) storage piles consisting of erosive material are covered with plastic tarps (or similar) and surrounded with straw bales. (Material used within 12 hours of deposition is not considered a temporary material storage pile.)

The intent of this MM is to prevent temporary material stock piles from being flooded by streams or rivers and washed into natural water bodies.

The standard specifications do not specify the locations where material stockpiles can be placed.

If possible, the designer should identify the 100-year floodplain in relation to the project site.

If the required quantity of plastic covering is significant, the special provisions should include it as a bid item.

MM 36. BMPs will be used for all projects within 61 meters (200 feet) of surface water or wetland habitat as identified by the project biologist, to ensure that no foreign material (such as pavement slurry from asphalt grinding equipment) is sidecast, and to control and prevent sediments from entering aquatic systems.

The intent of this MM (similar to MMs 25 and 33) is to prevent construction waste materials from entering sensitive areas.

BMPs chosen by the engineer during the design phase should be incorporated into the TESC plan and special provisions, in accordance with Section 8-01.3(1)A of the standard specifications. Additionally, all sensitive areas to be protected must be clearly identified on the contract drawings.

MM 37. BMPs will be implemented to ensure that no foreign material such as oil or fuel from construction equipment enters marine waters and that sedimentation is minimized.

The intent of this MM is to prevent spills from construction equipment or sediments from entering marine waters.

While prevention of water pollution is a requirement in the standard specifications, this MM is not specifically addressed. BMPs chosen by the designer during the design phase should be incorporated into the SPCC plan, TESC plan, and special provisions, in accordance with Section 1-07.15(1) of the standard specifications.

MM 38. All project-caused unstable slopes with a high likelihood of delivery to listed fish-bearing waters will be stabilized as soon as practicable.

The intent of this MM is to prevent the risk of unstable slopes sliding into natural water bodies.

This MM is not addressed in the standard specifications in the general manner stated above. This MM should be incorporated into the TESC plan and special provisions, in accordance with Section 8-01.3(1)A of the standard specifications. For the specifications to be useful, the designer should pay special attention to the definition of "project-caused unstable slopes."

MM 39. Large woody debris associated with project activities will be left in the riparian area if possible, or retained for future restoration use by WSDOT, or donated to a local watershed group if a need exists.

The intent of this MM is to take advantage of the habitat value of large woody debris by using it to restore riparian areas at the project site or in other restoration projects.

The standard specifications present general requirements for disposal of debris and materials generated during clearing and grubbing activities but do not require special handling or use of large woody debris. Designers should incorporate appropriate requirements into the special provisions to support this MM.

MM 40. No paving, chip sealing, or stripe painting will be initiated in rainy weather.

The intent of this MM is to prevent paving and painting materials from running off the construction site in stormwater and entering sensitive areas.

The standard specifications provide criteria to determine whether site conditions are adequate to ensure quality installation of paving and striping.[26] *However, depending on the sensitive nature of the site, the*

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26. Section 5-04.3(16) of the standard specifications – *Weather Limitations – Hot Mix Asphalt (HMA)*: *Hot mix asphalt shall not be placed on any wet surface*.

Section 5-02.3(10) – *Unfavorable Weather – Bituminous Surface Treatment*: *Asphalt shall not be applied to wet material*.

designer may wish to include stronger weather protection requirements in the special provisions for paving and striping projects.

Bridge Activities

MM 41. New stream crossing structures will not reduce the existing stream width.

The intent of this MM is to avoid loss of existing habitat area within streams where crossings are proposed.

This MM is not addressed in the standard specifications. Maintaining existing stream width should be addressed during the design phase and shown in the construction plans.

MM 42. Bridge construction will be conducted from the banks or temporary work bridges. Equipment will be kept out of rivers and streams as much as possible.

The intent of this MM is similar to MM 34.

MM 43. Bridge piers and abutments will be built outside the ordinary high water mark (OHWM).

The intent of this MM is to minimize artificial structures within fish habitat.

This MM is not addressed in the standard specifications. The engineer should address this MM during the design phase and designate the locations of bridge piers and abutments on the construction plans.

MM 44. No treated wood debris will be allowed to fall into the water. Any debris that falls in will be removed immediately.

The intent of this MM is to prevent treated wood debris from entering natural water bodies and contaminating them.

This MM is not specifically addressed in the standard specifications. Handling of treated wood should be incorporated into the special provisions. Depending on the site, it may be prudent to require drip tarps that contain and prevent the release of construction-generated debris to waters of the state.

MM 45. All treated wood will be disposed of at a disposal facility approved for treated wood.

The standard specifications require that debris and construction wastes be disposed of in accordance with all local, state, and federal laws. The designer should consider including a note or special provision to reference the standards.

MM 46. During bridge removal projects, as much of the existing structure as possible will be removed before finally dismantling the structure, to limit the amount of material and debris entering receiving waters. This includes all roadbed material, decking, concrete curbs, etc.

The intent of this MM is to prevent treated wood debris from entering natural water bodies and contaminating them.

This is not addressed in the standard specifications and should be incorporated into the special provisions and contract drawings by the designer (also see MM 44).

MM 47. Concentrated accumulations of bird feces, road grit, and sand will be removed from bridges by mechanical sweeping or by hand insofar as practicable before dismantling.

The intent of this MM is to prevent debris from entering and contaminating natural water bodies.

This MM is not specifically addressed in the standard specifications. Removal, containment, and handling of these items should be incorporated into the special provisions.

MM 48. All bridge removal projects will comply with water quality standards identified in the *WSDOT–Washington State Department of Ecology Water Quality Implementing Agreement* or approved temporary water quality modification permit in order to control turbidity levels within approved standards and prevent degradation of water quality.

The intent of this MM is to avoid water quality violations in natural water bodies.

This MM is generally addressed in the standard specifications by the requirement to comply with all local, state, and federal regulations and any permit requirements. However, the designer should address this MM during the design phase and incorporate appropriate BMPs into the construction plans and special provisions.

MM 49. Debris accumulations on the bridge, road surface, and within bridge drains will be collected or swept up and properly disposed of prior to flushing with fresh water. Flushing will involve the use of clean water only, to prevent detergents or other cleaning agents from entering waters of the state.

The intent of this MM is to prevent debris on bridges from entering and contaminating natural water bodies.

The standard specifications provide general requirements for control and containment of debris, along with specific measures to be implemented if debris is generated during preparation for painting.[27]

MM 50. Structural cleaning: Bridge structures will be pressure-washed using appropriate filter fabric to control and contain paint particles generated by the activity. Concentrated accumulations of bird feces and nests will not be allowed to drop into the water. This material will be scraped from the bridge structure and collected and disposed of at an appropriate upland location.

The intent of this MM is similar to MM 44.

The standard specifications generally provide for requirements in keeping with this MM.[28] *The designer may find it useful, however, to augment the specification language and include it in the special provisions as well.*

MM 51. Abrasive blasting containment: During abrasive blasting on a steel bridge prior to painting, a containment system appropriate for the type and location of the bridge will be in place and maintained to prevent spent blast media from reaching state waters. Spent blast media will be collected, sampled, classified for its hazardous material content, and disposed of as appropriate for its waste designation.

The intent of this MM is similar to MM 49.

The standard specifications generally provide for requirements in keeping with this MM.[29] *The designer may find it useful, however, to augment the specification language and include it in the special provisions as well.*

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27. Section 6-07.3(2)A of the standard specifications – *Bridge Cleaning*: *Following fungicide treatment and removal of bird guano, all steel surfaces to be painted shall be cleaned by either pressure flushing or sweep blasting. When pressure flushing is used, it shall be done with clean, fresh water only. No detergents, bleach, or other cleaning agents shall be employed.*

28. Section 6-07.3(2)A – *Bridge Cleaning*: *All washwater and debris from pressure flushing shall be filtered through a filter fabric capable of collecting all loose debris and particles*.

Section 6-07.3(2)A – *Bridge Cleaning: Bird guano shall be completely removed prior to any other cleaning. The bird guano shall be collected in a containment system approved by the engineer and shall not enter any waterway or the surrounding environment. All bird guano shall be removed and disposed of at a land disposal site approved by the engineer.*

29. Section 6.07.3(2)B – *Containment of Abrasive Blasting*: *At the preconstruction conference, the contractor shall submit a written containment system plan, including drawings and describing the methods for waste containment, collection, and disposal, to the engineer for approval. If the containment structure is removed after the abrasive blasting operation and before the coating operation, the contractor shall install a drip tarp to prevent spillage of paint on the waterway and ground surface below*.

Section 6-07.3(2)C of the standard specifications – *Testing and Disposal of Containment Waste: The contractor shall have spent blast media collected, sampled, designated for its hazardous material content, and disposed of as appropriate for its waste designation*.

Painting Activities

MM 52. Painters shall work from pails containing a maximum of 2 gallons of paint to minimize the impact of accidental spillage, except for sealed containers that are part of a spray system.

The intent of this MM is to minimize the amount of accidental paint spills potentially entering natural water bodies and other sensitive areas.

This MM is covered by the standard specifications for painting steel surfaces.[30] *The designer should confirm that the requirements apply to the site and should augment the special provisions as necessary.*

MM 53. Paint materials and maintenance equipment will not be cleaned in waters of the state, nor will resultant cleaning runoff be allowed to enter state waters.

The intent of this MM is to prevent paint materials from entering natural water bodies or other sensitive areas.

This MM is covered by the standard specifications for painting steel surfaces.[31] *The designer should confirm that the requirements apply to the site and should augment the special provisions as necessary.*

MM 54. Drip pans or other protective devices will be required for all paint mixing and solvent transfer operations.

The intent of this MM is similar to MM 53.

The standard specifications provide for containment beneath painting activities, but the designer should add language in the special provisions specifying requirements for paint mixing and solvent transfer operations to be conducted in designated areas that are fully protected by spill containment controls.

MM 55. Drip tarps will be suspended below paint platforms to prevent spilled paint, buckets, and brushes from entering state waters.

Subsurface Sampling Activities

MM 56. During subsurface sampling, when working off a highway, bridge deck, barge, or road surface within 100 feet of waters containing listed fish species,

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30. Section 6-07.3(2)G – *Painting Steel Surfaces*: *Painters using brushes shall work from pails containing a maximum of 2 gallons of paint in order to minimize the impact of any spill.*

31. Section 6-07.3(2)G – *Painting Steel Surfaces*: *Cleaning of equipment shall not be done in state waters, nor shall resultant cleaning runoff be allowed to enter state waters.*

a silt fence will be installed between the drilling site and the water body to contain sediments.

The intent of this MM is to prevent sediment-laden water created by subsurface sampling from reaching natural water bodies.

This MM is not addressed in the standard specifications. Subsurface sampling is typically a preconstruction activity. This MM should be communicated to the geotechnical engineer.

MM 57. During subsurface sampling within 100 feet of waters containing listed fish species, where practical, all materials removed from the test hole will be removed from the site.

The intent of this MM is to prevent foreign material from entering natural water bodies.

MM 58. During subsurface sampling within 100 feet of waters containing listed fish species, oil-absorbent pads will be placed under the drill rig to catch and control spills.

The intent of this MM is to prevent drill rig oil spills from entering natural water bodies.

MM 59. For subsurface sampling within 100 feet of waters containing listed fish species, the team lead will have a minimum of 4 hours training on erosion control, spill control, and containment.

The intent of this MM is to prevent spills and sediments from entering natural water bodies.

MM 60. For subsurface sampling within 100 feet of waters containing listed fish species, all existing large woody debris will be left onsite.

The intent of this MM is to prevent loss of habitat by keeping large woody debris onsite.

Stream Bank Activities

MM 61. When feasible, on stream bank protection and slide repair projects, fish habitat improvement measures will be evaluated and implemented by incorporating available large woody debris (LWD) and boulders in the bank protection or repair design.

The intent of this MM is to take advantage of existing large woody debris and boulders that can be incorporated into the design.

This MM is not addressed in the standard specifications. The special provisions should specify that existing large woody debris and boulder material may be used if approved for use by the engineer.

MM 62. Projects that include bank stabilization will follow the *Integrated Stream Bank Protection Guidelines* insofar as practicable.

The intent of this MM is to ensure that bank stabilization projects are appropriately designed and will achieve their objectives.

This MM is not addressed in the standard specifications. The engineer should design bank stabilization projects in accordance with appropriate guidelines and incorporate necessary measures into the construction plans and special provisions.

Temporary Access Roads

MM 63. The development and use of temporary access roads will meet the following conditions:

a) Existing roadways or travel paths will be used whenever reasonable.

b) Where stream crossing are essential, the crossing design will accommodate reasonably foreseeable risks (such as flooding and associated bedload and debris) to prevent diversion of streamflow out of the channel and down the road in the event of a crossing failure.

c) Vehicles and machinery must cross riparian areas and streams perpendicular to the main channel whenever reasonable.

d) Preparation of temporary roads within 150 feet of streams will avoid or minimize soil disturbance and compaction by clearing vegetation to ground level, then either placing clean gravel over geotextile fabric, or using hog fuel (i.e., hog chips) as the temporary road surface. All affected areas will be scarified and replanted, as appropriate, following removal of the temporary road.

e) The number of stream crossings will be minimized.

The intent of this MM is to minimize impacts associated with access roads through sensitive areas, including streams and riparian areas.

This MM is not addressed in the standard specifications. The engineer should consider this MM during the design phase and designate the location of access roads on construction plans. Information pertaining to proper materials and methods of building the access roads should be stated in the special provisions.

6.4.2.2 Examples of MMs and BMPs: Sensitive Terrestrial Habitat

Examples of MMs and BMPs identified for projects located near sensitive prairie habitat, sand dunes, salt-spray meadows, open-field habitat, nesting sites, or marbled murrelet habitat include but are not limited to the following:

MM 64. A temporary erosion and sedimentation control (TESC) plan and a source control plan will be developed and implemented for all projects requiring clearing, vegetation removal, grading, ditching, filling, embankment compaction, or excavation. The BMPs in these plans will be used to control sediments from all vegetation-disturbing and ground-disturbing activities.

MM 65. No contractor staging areas will be allowed within 61 meters (200 feet) of potential prairie habitat, as identified by the project biologist, unless site-specific review completed by the project biologist indicates that no impacts to the sensitive resource areas will occur due to topography or other factors.

MM 66. BMPs will be implemented for all projects within 61 meters (200 feet) of prairie habitat to minimize sediment impacts and to ensure that no foreign material (such as pavement slurry from grinding equipment) is sidecast or stored in prairie habitat.

MM 67. BMPs will be implemented for all projects within 61 meters (200 feet) of sand dunes, salt-spray meadows, or open-field habitat (including suitable Oregon silverspot butterfly habitat) to minimize sediment impacts and to ensure that no foreign material (such as pavement slurry from grinding equipment) will be sidecast or stored on dunes or meadows. The distance from sand dunes, salt-spray meadows, or open-field habitat where BMPs will be necessary may be modified by the project biologist after a site-specific review is conducted to ensure that no impact will occur.

MM 68. An individual management plan will be prepared for all individual bald eagle nest trees located on WSDOT right-of-way land within 660 feet and in line of sight of a project area.[32]

The intent of this MM is to avoid impacts on suitable bald eagle habitat.

This MM is not addressed in the standard specifications and should be incorporated into the special provisions as necessary and implemented prior to construction activities.

32. This distance is based upon the distances specified for category A activities in USFWS' Draft Bald Eagle Management Guidelines available on the reference CD accompanying this manual.

MM 69. All trash, food waste, and other items attractive to crows, jays, and other Corvidae will be picked up and removed from the project area on a daily basis for projects within 1.6 kilometers (1 mile) of suitable or critical marbled murrelet nesting habitat.

The intent of this MM is to prevent potential predation of murrelet nestlings by corvids.

This MM is not addressed in the standard specifications and should be incorporated into the special provisions.

MM 70. Construction of new facilities such as rest area maintenance facilities within 5 miles of suitable or critical marbled murrelet nesting habitat will implement a trash handling plan to ensure that food wastes and other items attractive to crows, jays, and other Corvidae will be removed and unavailable to wildlife.

The intent of this MM is to prevent potential predation of murrelet nestlings by corvids.

This MM is not addressed in the standard specifications but should be implemented after construction.

MM 71. Trees that are removed in suitable spotted owl or murrelet habitat are to be dropped into the road right-of-way or in other areas that will be cleared. Where large woody debris is lacking in adjacent forests, felled trees are to be placed in the forest, where practicable and agreeable to the adjacent property owner, following coordination with and approval by USFWS.

When it is absolutely necessary to remove trees in suitable spotted owl or murrelet habitat, the intent of this MM is to reintroduce the trees as large woody debris (LWD) habitat on the forest floor. This way, the trees can be put to a good use and provide habitat for small mammals and other wildlife. In addition, the felled trees can function as nurse logs for other vegetation such as red huckleberry and western hemlock trees.

This MM is not addressed in the standard specifications. The designer should specify the locations for placement of large woody debris on the construction plans or provide measures in the special provisions for a biologist to approve locations during construction.

MM 72. Projects involving bridge replacement within the range of the grizzly bear will design the new structure to accommodate wildlife crossings, when practicable.

The intent of this MM is incorporate measures that support the recovery of grizzly bears.

This MM is not addressed in the standard specifications and should be incorporated into the construction plans and special provisions.

MM 73. No contractor staging areas will be allowed within 200 feet of northern wormwood habitat as identified by the project biologist.

7.0 Noise Impact Assessment

7.0 Noise Impact Assessment

Chapter Summary

- The two most common types of noise based on attenuation dynamics are point source and line source.
- Natural factors such as topography, vegetation, and temperature can reduce noise over distance. A hard site exists where sound travels away from the source over a generally flat, hard surface such as water, concrete, or hard-packed soil. When ground cover or normal unpacked earth is present between the source and receptor, the ground becomes absorptive to sound energy and is called a soft site.
- Topography, *v*egetation, and atmospheric factors can also affect the rate of sound attenuation.
- Existing ambient noise levels can serve as a baseline from which to measure potential disturbance caused by project activities. Baseline (ambient) noise levels vary greatly and depend on site-specific factors.
- Most transportation projects involve traffic noise. Identifying the amount and type of traffic helps to determine the baseline (ambient) noise conditions.
- One of the hardest things to quantify is noise associated with construction activities.
- Although noise from multiple sources at the same location results in louder levels than a single source alone, the decibel is on a logarithmic scale, so sound levels cannot be added by standard addition.
- For transportation projects, traffic noise typically determines the baseline noise level in the project area.
- In the absence of traffic, community or environmental noise levels may be important in project noise analysis.
- Defining the extent of project-related noise requires the following steps:

  1. Estimate the equipment noise level for the project.
  2. Estimate the baseline (ambient) noise level. In most cases this can be done by defining traffic noise in the project area. In situations where ambient sound levels include intermittent peaks, try to identify the general ambient condition. For example, at a ferry terminal, the ferry whistle is usually the loudest ambient noise

source. However, it would be more meaningful to the analysis to use the ambient condition without such intermittent peaks to compare to project-related noise.

3. Determine whether hard or soft site conditions exist.

4. Determine whether the noise is point source or line source noise.

5. Develop an attenuation table displaying distance and decibel level to compare traffic noise attenuation with construction noise. Graph the attenuation in a simple spreadsheet program, and plot a graph that linearly displays the attenuation rate for each source of noise. The point where the two lines cross represents the distance where construction noise is indistinguishable from traffic noise.

- Different species exhibit different hearing ranges, so appropriate sound metrics and frequency ratings should be used when possible.

- The threshold distance is defined as a known distance where noise at a given level elicits some response from a target species.

- The analysis for a species should estimate sound-only detectability thresholds, sound-only alert and disturbance thresholds, and sound-only injury.

- Water currents bend underwater sound waves upward when propagated into the current and downward downstream. Sound waves bend toward colder, denser water.

- Underwater sound levels are measured with a hydrophone, or underwater microphone, which converts sound pressure to voltage, expressed in pascals (Pa), pounds per square inch (psi), or decibels (dB).

- Transmission loss (TL) underwater is the accumulated decrease in acoustic intensity as an acoustic pressure wave propagates outward from a source. The intensity of the source is reduced with increasing distance due to spreading.

- Noise propagation factors in water include hydrographic conditions that affect sound transmission, such as currents or tides, sediment types, bottom topography, structures in the water, slope of the bottom, temperature gradient, and wave height.

- Existing underwater noise levels serve as a baseline from which to measure potential disturbance associated with project activities.

- When analyzing the extent of project-related noise, consider the area underwater through which the sound travels until it reaches ambient levels.
- The steps for defining the extent of project-related noise are as follows:
  1. Estimate the equipment noise level for the project.
  2. Estimate the baseline (ambient) noise level.
  3. Determine applicable noise reduction factors.
  4. To determine the decrease in intensity of the sound away from the source, calculate noise attenuation at 0.07 decibels per meter (in river systems) or 0.15 decibels per meter (in Puget Sound).
  5. Calculate the potential distance in which project noise will attenuate to ambient levels.
- The project biologist must analyze the effects of noise on all species addressed in the BA.
- For aquatic species, risk of injury or mortality resulting from noise is generally related to the effects of rapid pressure changes, especially on gas-filled spaces in the animal's body (e.g., swimbladder, lungs, sinus cavities, etc.).
- Threshold distances and sound levels have been established to be used as a basis for effect determinations for salmon, bull trout, and diving marbled murrelets.

Noise from project activities can adversely affect wildlife in various ways. This chapter provides guidance on identifying construction-related noise and noise impacts in both terrestrial and in-water settings. Basic acoustic concepts are covered, including noise generation, transmission, and reduction. Identifying ambient or baseline noise levels for comparison with anticipated project-related noise can assist the project biologist in more accurately identifying the extent of project-related noise, in turn, potential impacts on listed species.

Noise can be characterized as unwanted sound, and in this chapter, *sound* and *noise* are used interchangeably. Two other terms used in this chapter are *source* and *receiver*. In terms of hearing, the source is where a sound comes from, and the receiver is the recipient of the sound (e.g., human, eagle, microphone, etc.).

For the project biologist's purpose, this discussion focuses on noise levels and the potential for impacts on wildlife. Noise transmission through air and impacts on terrestrial species are addressed first. Next, underwater noise, sound pressure levels, and their effects on fishes and diving marine birds are discussed.

7.1 Terrestrial Noise

Sound is transmitted through air when an object moves, like water flowing over rocks, or air passing through vocal cords. This movement causes air waves, similar to ripples in water. When these waves reach human ears, they are transformed into sound. Sound is usually measured in decibels (dB). A decibel is a relative measure, not an absolute measure, that is accompanied by a reference scale (dB = 20 * log(P1/Pr), where P1 is the measured sound pressure and Pr is the reference pressure), and denotes the Sound Pressure Level (SPL). Sound pressure is often expressed in decibels because of the wide range of pressure stimuli in the environment (many orders of magnitude). Table 7-1 shows typical sound levels generated by common indoor and outdoor activities, with human response.

Table 7-1. Sound levels and human response.

Common Sounds	Noise Level (dBA)	Effect
Rocket launching pad (no ear protection)	180	Irreversible hearing loss
Carrier deck jet operation Air raid siren	140	Painfully loud
Thunderclap	130	Painfully loud
Jet takeoff (200 feet) Auto horn (3 feet)	120	Maximum vocal effort
Pile driver Rock concert	110	Extremely loud
Garbage truck Firecrackers	100	Very loud
Heavy truck (50 feet) City traffic	90	Very annoying Hearing damage (8 hours)
Alarm clock (2 feet) Hair dryer	80	Annoying
Noisy restaurant Freeway traffic Business office	70	Telephone use difficult
Air conditioning unit Conversational speech	60	Intrusive
Light auto traffic (100 feet)	50	Quiet
Living room Bedroom Quiet office	40	Quiet
Library/soft whisper (15 feet)	30	Very quiet
Broadcasting studio	20	Very quiet
	10	Just audible
Threshold of hearing	0	Hearing begins

From <http://www.nonoise.org/resource/educat/ownpage/soundlev.htm>.

In-air sound (which commonly is frequency-weighted to approximate human hearing) is measured on an A-weighted scale, denoted as dBA.[33] The A-weighted decibel scale begins at zero, which represents the faintest sound that humans can hear. How loud a sound is (or how loud it seems to humans) can vary from person to person. However, because decibels are measured on a logarithmic scale, a sound level of 70 dBA is twice as loud to the listener as a sound of 60 dBA (USDOT 1995).

7.1.1 Noise Generation, Transmission, and Reduction

7.1.1.1 Noise Sources

Sound is a pressure wave that decreases over distance from the source. Noise attenuation is typically described as a set reduction in decibel level per doubling of distance from the source. Depending on the nature of the noise source, sound propagates at different rates. Measures of sound level from a source should specify the distance from the source. The standard reference distance for sound levels at the source is 50 feet. The two most common types of noise are point source and line source. These are discussed in more detail below.

Point Source Noise

Point source noise is associated with noise that remains in one place for extended periods of time, such as with construction activities. A few examples of point sources of noise are pile drivers, jackhammers, rock drills, or excavators working in one location. Noise from a single traveling vehicle is also considered point source noise.

Point source noise is commonly measured in peak decibel levels, or the highest value of a sound pressure over a stated time interval (Harris 1991). Noise from a point source spreads spherically over distance. Think of this as a 3-dimensional model, where the wave spreading creates a dome effect, traveling in all directions equally from the source. The standard reduction for point source noise is 6 dB per doubling of distance from the source.

Line Source Noise

Line source noise is generated by moving objects along a linear corridor. Highway traffic is the best example of line source noise. Line source noise levels are measured as an average over time rather than peak levels measured in point source noise.

Noise from a line source spreads cylindrically, spreading outward along the length of a line. The standard reduction for line source noise is 3 dB per doubling of distance from the source (compared to 6 dB for point source noise).

Table 7-2 provides an example of noise attenuation of point and line source decibel levels based on distance from the source.

33. For sound pressure in air, the reference amplitude is usually 20 micro-pascals (ΦPa). One pascal is the pressure resulting from a force of one newton exerted over an area of one square meter. Sound measured on an A-weighted scale is in reference to 20 ΦPa in this document.

Table 7-2. Example of noise reduction over distance from 95 dBA source showing variation between point source and line source.

	Noise Attenuation	
Distance from Source (feet)	Point Source (–6 dB)	Line Source (–3 dB)
50	95 dBA	95 dBA
100	89 dBA	92 dBA
200	83 dBA	89 dBA
400	77 dBA	86 dBA
800	71 dBA	83 dBA
1,600	65 dBA	80 dBA
3,200	59 dBA	77 dBA
6,400	53 dBA	74 dBA

7.1.1.2 Noise Reduction Factors

Natural factors such as topography, vegetation, and temperature can further reduce noise over distance. This section covers a few of the common factors and their applicability in increasing the noise reduction per doubling of distance from the source.

Hard Site versus Soft Site

A hard site exists where sound travels away from the source over a generally flat, hard surface such as water, concrete, or hard-packed soil. These are examples of reflective ground, where the ground does not provide any attenuation. The standard attenuation rate for hard site conditions is 6 dB per doubling of distance for point source noise and 3 dB per doubling of distance from line sources.

When ground cover or normal unpacked earth (i.e., a soft site) exists between the source and receptor, the ground becomes absorptive to sound energy. Absorptive ground results in an additional noise reduction over distance of 1.5 dB per doubling of distance. Added to the standard reduction rate for soft site conditions, point source noise attenuates at a rate of 7.5 dB per doubling of distance, and line source noise decreases at a rate of 4.5 dB per doubling of distance.

Topography, Vegetation, and Atmospheric Factors

A break in the line of sight between the noise source and the receptor can result in a 5 dB reduction. Dense vegetation can reduce noise levels by 5 dB for every 100 feet of vegetation, up to a maximum reduction of 10 dB (USDOT 1995). Atmospheric conditions can also affect the rate of sound attenuation. Sound travels farther during periods of higher humidity and also in colder temperatures (USDI 2003). Wind can reduce noise levels by as much as 20 to 30 dB at long distances (USDOT 1995).

The influences of vegetation, topography, and atmospheric conditions as noise reduction factors can vary greatly and are often impossible to quantify. Therefore, these factors are generally not taken into account in environmental noise analyses, which likely results in predicted noise levels that are higher than actual noise levels.

7.1.2 Baseline Noise Conditions

Existing ambient noise levels can serve as a baseline from which to measure potential disturbance caused by project activities.

7.1.2.1 Environmental Conditions

Baseline (ambient) noise levels vary greatly and depend on site-specific factors. Environmental factors can elevate baseline noise near the source, hiding construction noise. The same environmental factors occurring near the receiver can change the receiver's perception of how loud construction noise is, or hide it completely.

The few data that exist indicate baseline levels at known study sites of 35 to 88 dBA for undisturbed forested areas. A WSDOT noise assessment on the San Juan Islands identified a baseline of about 35 dBA at a bald eagle nest site, with regular noise intrusions from traffic and aircraft overflights ranging from 45 to 72 dBA (WSDOT 1994). A study on the Mt. Baker-Snoqualmie National Forest listed forested baseline levels between 52 and 60 dBA (USDA Forest Service 1996). The Olympic National Forest programmatic biological assessment uses an estimated baseline level of 40 dBA for undisturbed forested areas (USDI 2003). The environment surrounding transportation projects is often composed of high-speed highways, busy ferry terminals, and urban development. For projects occurring in these areas, baseline noise levels will be much higher than that of a forested or undeveloped setting.

Weather conditions such as wind or rainfall can increase baseline noise in undeveloped areas. Locations near rivers or streams have higher baseline noise levels as well. As with the atmospheric conditions described above, these environmental factors are variable and may be impossible to quantify, so they are rarely taken into account in noise models.

The WSDOT project biologist should check with the WSDOT Air, Noise, and Energy Program to see if baseline noise data are available for the project or similar areas. If baseline information is not available and noise may be a major concern in the consultation, the biologist may wish to make onsite noise measurements with a hand-held noise meter.

7.1.2.2 Traffic Noise

The majority of projects that the project biologist assesses encounters will involve traffic noise. Identifying the amount and type of traffic helps to determine the baseline (ambient) noise conditions. The level of highway traffic noise depends on the volume of traffic, the speed of the traffic, and the volume of trucks in the flow of traffic (USDOT 1995). Generally, the loudness of traffic noise is increased when traffic is heavier, when traffic speed is increased, and when a greater proportion of the traffic flow is heavy trucks.

For traffic volume, 2,000 vehicles per hour sounds twice as loud as (or is 10 dBA higher than) 200 vehicles per hour (USDOT 1995). As stated earlier, a noise that is increased by 10 dBA sounds twice as loud to the listener. For traffic speed, traffic at 65 miles per hour (mph) sounds twice as loud as traffic at 30 mph (USDOT 1995). In regard to the proportion of heavy truck traffic, one truck at 55 mph sounds as loud as 28 cars at 55 mph (USDOT 1995).

Vehicle noise is a combination of noises produced by engines, exhaust, and tires. The loudness of traffic noise can also be affected by the condition and type of roadway, road grade, and the condition and type of vehicle tires. Predictions of noise from vehicles are usually based on *reference energy mean emission levels*, which correspond to the noise level expected from a single vehicle at the standard 50-foot distance. Figure 7-1 shows the reference energy mean emission levels in dBA for automobiles (two axles with four tires), medium trucks (two axles with six tires), and heavy trucks (three or more axles).

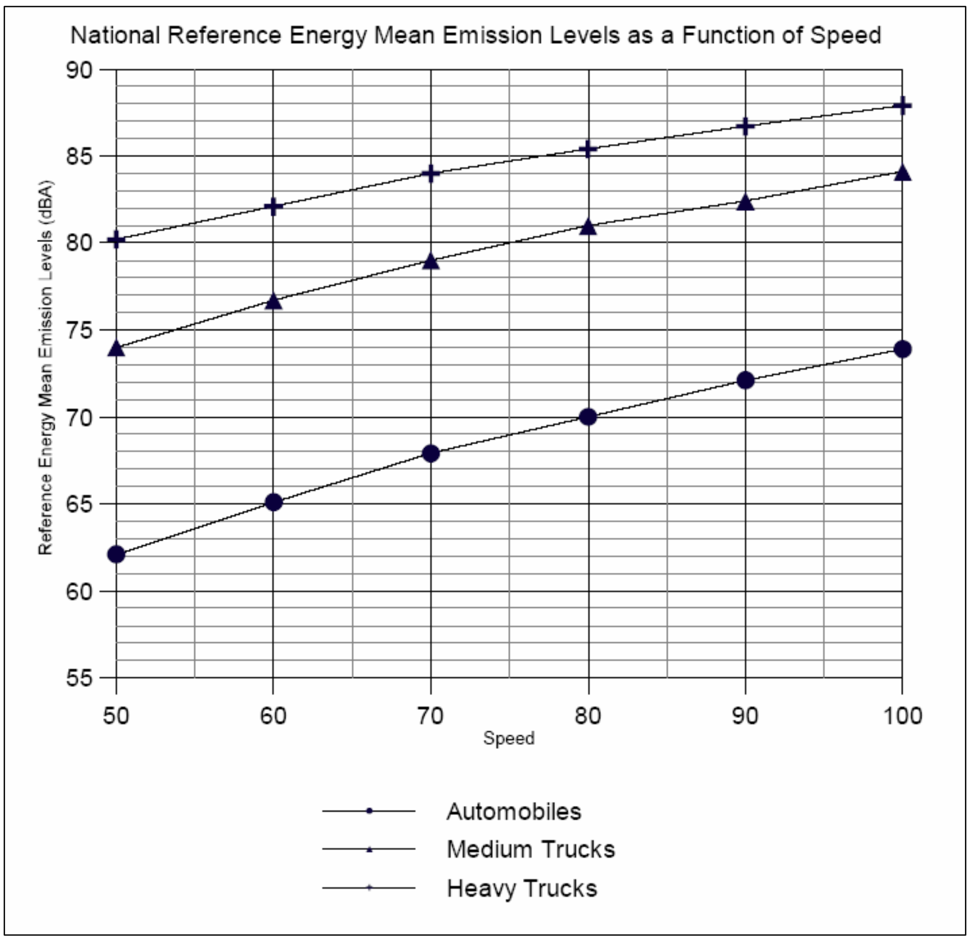


Figure 7-1. Reference energy mean emission levels.
(Note: Speed is in kilometers per hour.)

Table 7-3 lists typical traffic noise levels for a variety of roadway types, assuming heavy truck traffic and medium traffic volume. These numbers would be elevated as traffic volume increases.

Table 7-3.   Typical traffic noise levels.

Traffic Noise Levels				
Traffic Speed and Type	Busy City Street	35-40 mph Arterial (2-4 lanes, with stops and turn lanes)	45-60 mph Highway (2 lanes)	60+ mph Freeway (4-8 lanes)
Sound Level	80 dBA	82 dBA	86 dBA	88+ dBA

7.1.3   Construction Noise

One of the easiest things for the project biologist to identify and one of the hardest things to quantify is noise associated with the actual construction of the project. How much noise will construction generate, how often will it occur, and how long will it last are all questions that should be answered in the assessment. This section provides an introduction to equipment noise characteristics that the project biologist might expect for typical construction projects.

Construction is usually performed in a series of steps or phases, and noise associated with different phases can vary greatly. However, similarities in noise sources allow typical construction equipment to be placed into one of three categories: heavy equipment, stationary equipment, or impact equipment.

7.1.3.1   Heavy Equipment

Heavy equipment can be defined as earth-moving equipment, such as excavating machinery like excavators, backhoes, and front loaders, as well as handling equipment like graders, pavers, rollers, and dump trucks. Noise levels at 50 feet from heavy equipment range from about 72 to 97 dBA (Table 7-4). These numbers were identified from several studies, and represent a range of reported values. During the phase of construction using heavy equipment, noise is generated more or less at a constant level. Therefore, noise levels can be equated to an average hourly level.

Lacking onsite noise data, the project biologist should use the worst-case scenario of the known equipment noise levels above for the purpose of a noise assessment. . This is likely a conservative estimate, due to the fact that some of the data in Table 7-4 above is from sources over 20 years old, and more modern equipment operates under much more restrictive emission and noise standards. Manufacturers can also provide sound levels for their equipment, but the biologist must know the specific make and model of the equipment to be used for the project in order to obtain that information.

Table 7-4. Noise ranges at 50 feet from common construction equipment.

Equipment	dBA	Equipment	dBA
Heavy trucks	82–96	Backhoe	72–90
Grader	79–93	Paver (+ grind)	85–89
Excavator	81–97	Front loader	72–90
Crane	74–89	Generator	71–82
Pile driver	81–115	Jackhammers/rock drills	75–99
Concrete mixer	75–88	Roller	72–75
Compressor	73–88	Pumps	68–80

Sources: Bolt et al. (1971, 1987); Western Highway Institute (1971); WSDOT (1991, 1994, 1995, 2005); LSA Associates (2002).

7.1.3.2 Stationary Equipment

Stationary equipment such as pumps, power generators, and air compressors generally runs continuously at relatively constant power and speed. Noise levels at 50 feet from stationary equipment can range from 68 to 88 dB, with pumps typically in the quieter range. The biologist can also assume an averaged noise level for stationary equipment because of its fixed location and constant noise pattern.

7.1.3.3 Impact Equipment

This category includes pile drivers, jackhammers, pavement breakers, rock drills, and other pneumatic tools where a tool bit touches the work. The noise from jackhammers, breakers, rock drills, and pneumatic tools comes from the impact of the tool against the material. These levels can vary depending on the type and condition of the material. Noise levels at 50 feet from impact equipment, including pile drivers, jackhammers, and rock drills can range from 75 to 115 dB.

An impact pile-driving hammer is a large piston-like device that is usually attached to a crane. The power source for impact hammers may be mechanical (drop hammer), air steam, diesel, or hydraulic.

In most impact drivers, a vertical support holds the pile in place, and a heavy weight, or ram, moves up and down, striking an anvil that transmits the blow of the ram to the pile. In hydraulic hammers, the ram is lifted by fluid, and gravity alone acts on the down stroke. A diesel hammer, or internal combustion hammer, carries its own power source and can be open-end or closed-end. An open-end diesel hammer falls under the action of gravity alone. A closed-end diesel hammer (double-acting) compresses air on its upward stroke and therefore can run faster than open-end hammers.

Vibratory hammers can also be used on projects. A vibratory pile-driving hammer has a set of jaws that clamp onto the top of the pile. The pile is held steady while the hammer vibrates the pile to the desired depth. Because vibratory hammers are not impact tools, noise levels are typically not as high as with impact pile drivers. However, piles installed with a vibratory hammer must often be proofed, which involves striking the pile with an impact hammer to determine its load-bearing capacity, possibly with multiple impacts. In this case, noise is elevated to levels associated with impact pile driving. The project biologist should address proofing if vibratory hammers are used on a project and the piles are load-bearing.

Although stationary equipment noise and heavy equipment noise can be averaged over a period of time, pile-driving noise consists of a series of peak events. Generally, noise from pile driving has been reported at peak levels. The highest in-air noise from pile driving results from the impact of the hammer dropping on the pile, particularly when hollow steel piles are used. Therefore, the project biologist should assume that noise at the highest levels documented is commonly generated by pile driving and should avoid using an average in noise assessments

For the purposes of conducting an in-air noise assessment involving hollow steel piles, USFWS currently recognizes a sound level of 115 dBA Lmax (Visconty 2000) as a worst-case scenario for pile driving activities. Most of the documented studies have peak decibel levels between 95 and 115 dB, with only one documented level above 115 dB. Noise assessments by WSDOT have documented peak levels of 110 dB (WSDOT 1994, 1995). If site-specific information is available, it may be appropriate to substitute lower values.

Noise from blasting should be included in the discussion on impact equipment. Since blast noise typically is infrequent and of short duration, blast noise is generally assessed using a different noise metric than those used for other more continuous types of noise. Blasting can occur in different situations and is applied through a variety of methods. Due to the variability in blasting techniques and situations, noise from blasting is not fully addressed in this chapter. However, when addressing blasting, the project biologist should consider the following factors:

- Substrate – The location where blasting occurs partially determines the size of the charge and the duration of blasting. Blasting through bedrock requires more time and effort than blasting through less dense substrate.
- Size of charge – Blasting can use charges of less than a pound to over 200 pounds.
- Detonation system – Blasting may use a sequential delay system where each blast is subdivided into many smaller blasts, separated by a few milliseconds; or the blast may occur all at once.
- Directivity – Blasting above ground acts like point-source noise and spreads spherically from the source. Where blasting occurs below ground level, as in a shaft or pit, some directivity occurs, which directs the force of the blast upward more than horizontally, thereby lessening impacts.
- Use of BMPs – Best management practices may be used to lessen the energy of the blast. For example, when the charge is small enough, the

use of heavy mats to cover the charge can significantly reduce the blast energy and contain any flying debris.

7.1.3.4 Rules for Decibel Addition

Now that the project biologist can identify the type and level of construction equipment noise, it is important to discuss what happens when several pieces of equipment are operating at one time. Although noise from multiple sources at the same location results in louder levels than a single source alone, the decibel is on a logarithmic scale, so sound levels cannot be added by standard addition. Two sounds of equal level (±1 dB) combine to raise the noise level by 3 dB. However, if two sounds differ by more than 10 dB, there is no combined increase in the sound level; the higher output covers any other noise. The rules for decibel addition are shown in Table 7-5.

Table 7-5. Rules for combining sound levels.

When two decibel values differ by:	Add the following to the higher decibel value:
0 or 1 dBA	3 dBA
2 or 3 dBA	2 dBA
4 to 9 dBA	1 dBA
10 dBA or more	0 dBA

Source: USDOT (1995).

7.1.4 Determining the Extent of Project Related Noise

This discussion has introduced basic concepts and provided information on construction-related noise, traffic noise, and baseline noise levels. Using this information, the project biologist should be able to identify the extent of project-related noise, which represents one element of the project action area. This section provides instructions for establishing the extent of noise and defining the noise element of the action area.

7.1.4.1 Community Noise or Environmental Noise

For transportation projects, traffic noise typically determines the baseline noise level in the project area. However, it is also important to identify the project area baseline noise level in the absence of traffic. This noise level can be referred to as the environmental or community baseline noise level.

Baseline noise levels vary depending on the level of development. Urban areas have the highest baseline noise levels, with daytime levels of approximately 60 to 65 dBA (EPA 1978). Suburban or residential areas have baseline levels around 45 to 50 dBA (EPA 1978), while rural areas are the quietest with noise levels of 35 to 40 dBA (EPA 1978). In a more recent study, Cavanaugh and Tocci (1998) identify typical urban residential noise at around 65 dBA, high-density urban areas at 78 dBA, and urban areas adjacent to freeway traffic at 88 dBA. Community or environmental noise levels may be important in project noise analysis in the absence of traffic.

In urban and developed areas, traffic noise and construction noise attenuate (decline) to baseline levels in less distance than in undeveloped or rural areas. For example, it may take 2 miles or more for construction noise to reach baseline levels in a rural area, but the same noise may attenuate to urban baseline levels in less than a mile. For most transportation projects, however, traffic noise determines the baseline noise level.

7.1.4.2 Steps for Defining the Extent of Project-Related Noise

The following subsection provides instruction on using noise analysis to determine the extent of project-related noise and define the noise element of the action area. This does not provide the biologist all of the information needed to describe the action area; noise is just one element of the project that must be considered. See Chapter 8 for guidance on determining the action area.

The following information is provided in a step-by-step format with an accompanying example project.

1. **Estimate the equipment noise level for the project**. In order to estimate the noise level of project activities, it is imperative to know and understand all equipment that will be used for the specific project. The project biologist should avoid assuming the types of equipment that may be used and ask the project design or engineering office for specific information. Once all project equipment is known, use the decibel levels for common construction equipment found in Table 7-4. This table shows the noise range for common construction equipment from several sources. If specific noise levels are not known, take the highest noise level shown for at least the three noisiest pieces of equipment listed in the table. For pile driving, use a value of 115 dBA in absence of relevant data. Remember to use the rules of decibel addition for the final project noise level.

    - ***Example** – The equipment used will be an excavator, heavy trucks, finish grader, and paver. The estimated worst-case scenario noise level for the construction equipment is: excavator, 97 dBA; heavy trucks, 96 dBA; grader, 93 dBA, and; paver, 89 dBA. Remembering the rules for decibel addition (see Table 7-5), the most noise will be produced by heavy trucks and/or excavators at around 97 dBA. The next highest noise level will be produced by heavy trucks at 96 dBA. Therefore, add one decibel to the higher value, and it can be assumed that construction noise will not exceed 100 dBA.*

2. **Estimate the baseline noise level.** In most cases this can be done by defining traffic noise in the project area. There may be situations where baseline noise is greater than traffic noise, such as adjacent to airports. By using the information in Section 7.1.2.1, it is possible to estimate the

baseline noise level for the project area by assessing traffic. The project biologist should define the type of roadway and the speed limit in the project area. If roadway type and speed limit are not obvious, consult the Washington State Highway Log (WSDOT 2005b) for information. Using either the closest fit from Table 7-3 or the energy mean emission levels from Figure 7-1, estimate the decibel level of traffic in the project area. Remember that seasonality and the amount of heavy truck traffic can raise typical noise levels. The project biologist should also contact the WSDOT Air, Noise, and Energy program to ask if any acoustical monitoring has occurred in the project vicinity or in similar areas.

- ***Example*** *- The project is located on a 2- lane state highway in an undeveloped forested area. The speed limit in the project area is 60 mph, and current traffic levels will be elevated because of the seasonal use and include heavy truck traffic. Table 7-3 lists the noise level as 86 dBA for two-lane, 60 mph traffic, which is the best fit for the example. The 86 dBA level already incorporates the 3 dB addition for more than one automobile.*

3. **Determine whether hard or soft site conditions exist.** Section 7.1.1.2 describes the difference between hard and soft site conditions. A hard site exists where sound travels away from the source over a generally flat, hard surface such as water, concrete, or hard-packed soil. When ground cover or normal unpacked earth exists between the source and receptor, the ground becomes absorptive to sound energy and soft site conditions are present. Most project areas, other than sites adjacent to water or in developed areas having more than 90 percent concrete or asphalt, exhibit soft site conditions. For soft site conditions, add 1.5 dB to the standard reduction factor.

- ***Example*** *–Based on the location of the project in a forested setting, it can be assumed that soft site conditions exist. Therefore, add the additional 1.5 dB reduction on to the standard reduction factors.*

4. **Determine whether the noise is point source or line source noise –** Use Section 7.1.1.1 to determine whether construction noise and traffic noise are point or line source. Typically, construction noise has a point source, regardless of the activity. Even moving projects such as pavers attenuate noise in point source dynamics. Although construction activity may move, the noisy activity typically remains in one location.

   If multiple noisy activities are occurring at different locations throughout the project area, the extent of project-related noise should be described at each location. For example, pile driving could be occurring at one location in the project corridor, while pavement grinding or rock drilling may be occurring elsewhere.

Traffic noise is almost always line source noise. The standard attenuation rate for point source noise is 6 dB, and the standard attenuation rate for line source noise is 3 dB. These standard attenuation rates do not take into account any reduction factors, such as soft sites, vegetation, or atmospheric factors.

- ***Example** – All work on the project will occur at one location, and is considered point source noise. Therefore, adding the reduction for soft site conditions, construction noise will attenuate at a rate of 7.5 dB per doubling of distance. Traffic noise (line source) will attenuate at a rate of 4.5 dB per doubling of distance. This attenuation rate includes the 1.5 dB reduction for soft site conditions.*

5. **Develop an attenuation table** – The easiest way to compare traffic noise attenuation with construction noise attenuation is to construct a side-by-side table. Using the predicted levels, an attenuation table can be made displaying distance and decibel level. In noise assessments, 50 feet is the standard distance used to describe initial decibel levels. Therefore, the initial distance for known or predicted levels is 50 feet. The extent of noise from construction activity is defined as the limit where noise from construction equipment is indistinguishable from noise generated by the roadway (baseline). An attenuation table can define the first estimate of the extent of project-related noise. Step 6 below describes how to develop an attenuation graph and use equations to further define the noise extent.

    - ***Example** – Project-related noise is estimated at 100 dBA, and traffic noise is estimated at 86 dB. Table 7-6 was generated using the predicted construction and traffic noise levels and the attenuation rates for each. In this example project, it would be safe to define the extent of project-related noise between 800 and 1600 feet, because it can be seen from the table that this distance is where construction noise levels have attenuated to the same level as traffic noise.*

6. **Graph the attenuation rates** – By developing the attenuation table above in a simple spreadsheet program, a graph can be made that linearly displays the attenuation rates for each source of noise. The point where the two lines cross represents the distance where construction noise is indistinguishable from traffic noise.

Table 7-6. Example noise attenuation table.

Noise Attenuation Table (Example)		
Distance from Roadway (ft)	Construction Noise (–7.5dB)	Traffic Noise (–4.5dB)
50	100 dBA	86 dBA
100	92.5 dBA	81.5 dBA
200	85 dBA	77 dBA
400	77.5 dBA	72.5 dBA
800	70 dBA	68 dBA
1,600	62.5 dBA	63.5 dBA
3,200	53 dBA	59 dBA
6,400	45.5 dBA	54.5 dBA
12,800	38 dBA	40 dBA

The distance where construction noise has attenuated to baseline noise is at after 800 feet.

Figure 7-2 graphically displays the attenuation rates for construction equipment noise and traffic noise. Add a logarithmic trendline by selecting the line, and choose to display the equation on the chart. By using this trendline equation, the decibel level can be calculated at known distances. Note the trendline equation is specific for the set of variables that are input, and is not always the same as that listed here.

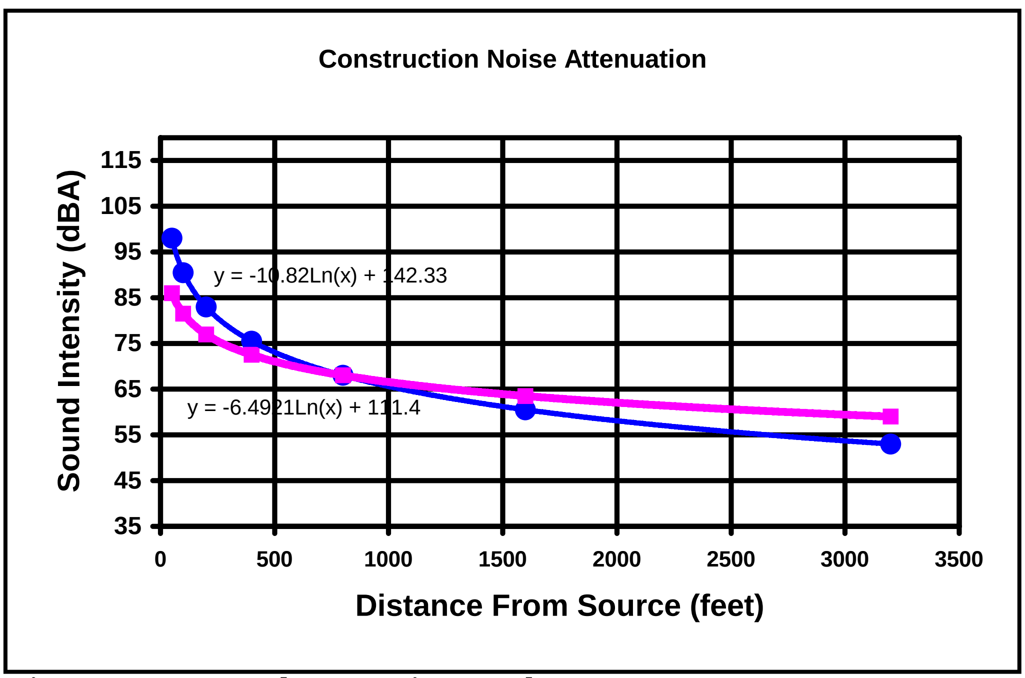


Figure 7-2. Sound attenuation graph.

- ***Example*** *– In this example, the trendline equations for attenuation are:*

  Construction noise – noise level (dBA) = –10.82●ln(x) + 142.33)
  Traffic noise – noise level (dBA) = –6.4921●ln(x) + 111.4)

  where x is the distance in feet from the origin of the sound. In the graph, the construction activity noise trend line crosses the traffic noise trend line between 800 and 1600 feet. To pinpoint where construction noise is the same as traffic noise, use the equations to solve for a specific distance.

If the project occurs in a developed area, the biologist can also use known baseline noise levels associated with the level of development, and determine when construction noise drops below that level to identify the extent of project-related noise. A noise study for this example project states an 85 dB baseline is present. From the example project above, a 100 dBA noise level was assumed for project activities. Using the equation for construction noise attenuation, construction noise would have attenuated to background levels at 200 feet from the project.

The WSDOT Air, Noise, and Energy program is currently developing a noise model that can aid the project biologist in determining the extent of project related noise. The model is intended for ease of use and to provide a definable extent of the noise until it diminishes to baseline levels. The user inputs the decibel levels for the three loudest pieces of equipment, traffic volume and type of vehicle, allowable speed limit, site surface characteristics, and target decibel level based on land use. The model calculates expected noise levels from these sources and the diminishing effects from vegetation, molecular absorption, atmospherics, and the physics of noise waves. The distance product is the worst-case scenario and does not take into account topography and naturally occurring noises such as water and wind. While the model will be applicable for most situations, it may not be appropriate to use the model for long linear projects that pass through numerous habitats or topographic features.

7.1.5 Species and Noise

So far, this discussion has focused on noise dynamics, generation, and prediction. The ability to identify and measure noise is only part of the assessment. The project biologist is also tasked with addressing the effects of noise on the species addressed in the BA.

7.1.5.1 How Animals Hear

Many animals can hear sounds with frequencies above and/or below the range of human hearing. Some animals have ears that can move and which are shaped to help localize the direction from which sound originates. Much is not known, but it is assumed that animals in general have better hearing than humans.

Not all animals respond the same way to similar noise sources, and not all individuals respond the same way within a species. Animal response to noise depends on a number of complicated factors, including sound level and frequency, distance and event duration, equipment type and condition, frequency of noisy events over time, slope, topography, weather conditions, previous exposure to similar sounds, hearing sensitivity, reproductive status, time of day, behavior during the noise event, and the animals location relative to the sound source (Delaney and Grubb 2003).

Different species exhibit different hearing ranges, so appropriate sound metrics and frequency ratings should be used when possible. For in-depth noise studies and hearing assessments, sound must be measured in a way that meaningfully correlates with the target species response. In this assessment, all decibel levels have been given as frequency weighted to approximate the way that humans hear. A-weighting (dBA) deemphasizes the upper and lower portions of the frequency spectrum, while emphasizing the middle portion of the spectrum (where humans have the greatest sensitivity). An audiogram (Figure 7-3) can describe the hearing range sensitivity for different species.

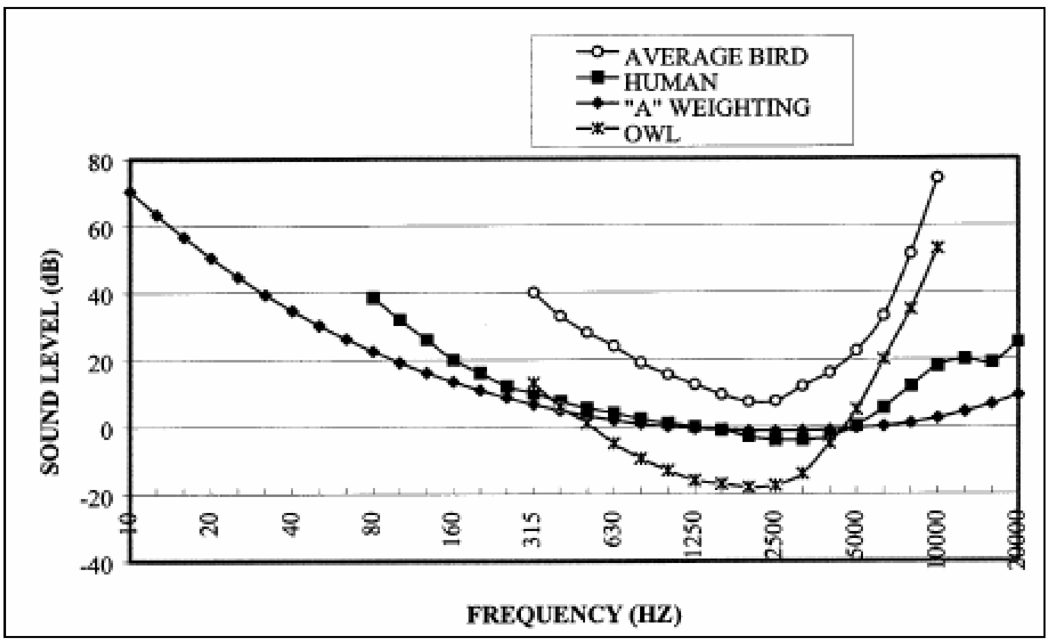


Figure 7-3. Example audiograms.
Source: Pater et al. (1999).

Notice how owls have better hearing than humans since they can detect sounds in the same frequency range at lower decibel levels.

For example, an owl-weighted curve would emphasize the middle frequency range where owls have the highest hearing sensitivity. The information presented in this discussion only uses A-weighted noise as a predictive factor. To describe effects on species, known threshold distances may constitute the best available science.

7.1.5.2 Threshold Distances and Effect Determinations

Threshold distances are defined as a known distance where noise at a given level elicits some response from a target species. This response can be visual, as in head-turning or flushing from a nest, or the animal may show little reaction. Particularly in birds, little or no reaction does not mean that no effect has occurred.

The U.S. Fish and Wildlife Service (USFWS) has provided WSDOT a copy of its biological opinion (BO) for the Olympic National Forest program of activities (USDI 2003). The USFWS updated Appendix 1 of the BO in September 2004. Appendix 1 provides estimates of sound levels at which incidental *take* of marbled murrelets and northern spotted owls is expected to occur due to harassment from noise-generating activities. The BO establishes harassment levels for noise-generating activities specific to marbled murrelets and northern spotted owls.

This guidance from USFWS is intended for use in certain situations and was developed for a specific program of activity. The threshold levels are a tool that may be used by the biologist in certain situations to assist in making effect determinations for marbled murrelets and northern spotted owl. By using the information above regarding identifying the project-related noise extent, the biologist can determine the distance at which the established threshold levels are located in relation to suitable habitat or documented species.

Harassment distance is the distance from an activity at which incidental *take* occurs due to harassment. Within the BO, harassment distances and effect determinations for activities including but not limited to blasting, pile driving, and heavy equipment operation are defined (see Chapter 13 for effect determination guidance). In a previous BO for the Olympic National Forest, the USFWS used a standard 0.25-mile distance from most noise generating activities. In this BO, threshold distances in most cases are reduced significantly, based on noise analysis provided in Appendix 1 of the BO.

The analysis determined noise levels at a distance by using a 7.5 dB doubling distance reduction from noise-generating activities. They estimated the sound-only injury threshold for murrelets and owls is approximately 92 dBA at nest sites. This level does not change. Disturbance thresholds were estimated at 70 dBA, and detectability thresholds were estimated at 44 dBA. For the biologist’s purpose, this threshold level applies in similar settings to that found in the Olympic National Forest – generally undeveloped forested areas. The disturbance and detectability thresholds can vary, depending on the ambient noise level. The process that was used to determine the sound-only detectability, alert, disturbance, and injury threshold distances is outlined below:

- ***Sound-only detectability threshold*** (where the sound is detectable, but a murrelet or spotted owl does not show any reaction) – The detectability threshold was identified as being 4 dB above the baseline noise level. For example, in the Olympic National Forest biological opinion, baseline noise levels were identified at 40 dBA; therefore the detectability threshold was 44 dBA. This number varies based on baseline noise levels.

Dooling and Hulse (1989) noted that 16 species of birds showed an average sensitivity of 4 dBA to detect a sound (in USDI 2003).

- ***Sound-only alert and disturbance thresholds*** (alert is where the murrelet or spotted owl shows apparent interest by turning the head or extending the neck; disturbance is where the murrelet or spotted owl show avoidance of the sound by hiding, defending itself, moving the wings or body, or postponing a feeding) – These threshold levels could not be documented with any precision, so they were subjectively placed between the detectability threshold and the injury threshold. The alert threshold is 57 dBA and the disturbance threshold is defined as 70 dBA. These thresholds will change depending on the baseline noise level and do not widely apply.

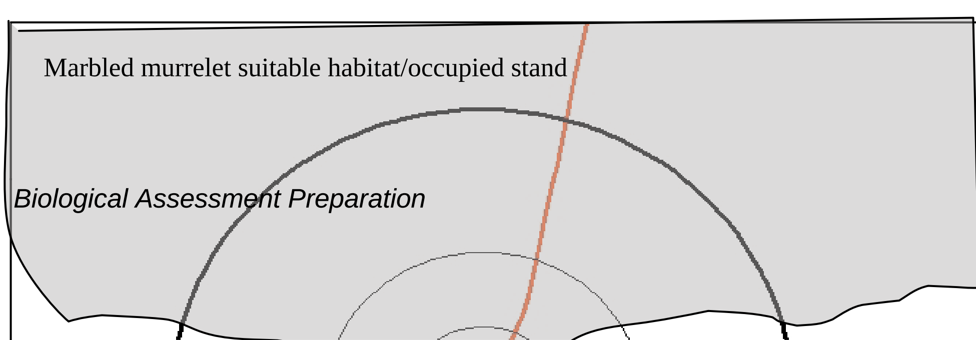
- ***Sound-only injury threshold*** (where the murrelet or spotted owl is actually injured, defined as an adult flushed from the nest or the young missing a feeding) – This distance was estimated using known data from several studies that documented sound-only flushes for several bird species. Based on the results of the studies, the sound-only injury threshold is 92 dBA. The detectability, alert, and disturbance threshold will differ as baseline noise differs, but this 92 dBA level remains constant.

7.1.5.3 Extent of Project-Related Noise versus Effects to Species

One of the biggest mistakes made in writing a BA is to define the action area in terms of the extent of impacts on species rather than the zone of impact for the physical, chemical, and biological effects of the action.

To illustrate the concept of the project-related noise extent versus impacts on species, this section combines the noise assessment information from Section 7.1 through Section 7.1.4.1 with the established threshold level information to determine the effects to species and aid in reaching an effect determination. The following figures are based on the example project presented in Section 7.1.4.2.

In Figure 7-4, the project area is the dot in the center of the figure. The concentric circles show the noise attenuation distances for construction and traffic noise. The two small tables with the figure show the noise levels and distances from the example for construction and traffic noise attenuation. Also displayed are a bald eagle nest site, a spotted owl nest site and suitable habitat, and marbled murrelet suitable habitat/occupied stand. These locations are placed only for the purposes of the example.



Construction dBA	
200 feet	83 dBA
400 feet	75.5 dBA
800 feet	68 dBA

Traffic dBA	
200 feet	77 dBA
400 feet	72.5 dBA
800 feet	68 dBA

Figure 7-4. Example project area and species occurrence.

Remember from the example above the extent of project-related noise was determined to be 800 feet. This distance is shown in these figures as the heavier line. For this example, assume that the noise element is the farthest-reaching impact from construction activities; therefore, this distance represents the project action area. The impact to species in this example is solely based on project-related noise. Chapter 8 describes using all elements of the project to determine the action area.

- **Bald eagle –** The bald eagle nest is located over 800 feet from the project area and is not in line-of-sight of the activity. The darker circle represents the point where project-related noise has attenuated to baseline levels based on traffic. Therefore, bald eagles at this location will not be impacted by project-related noise. Keep in mind these effects are for sound-only disturbance, and other elements of construction could affect the bald eagles.

- **Northern spotted owl –** The spotted owl nest site is located about 600 feet from the project area. Based on the example model above and using the trend line equation, the predicted decibel level from project-related noise at the nest is about 71 dBA. This is above the somewhat arbitrary disturbance threshold of (70 dBA), and below the injury threshold of 92 dBA. Because the nest is located in a zone where an owl could hear and show disturbance from the noise, project-related noise may or may not have an adverse impact. Noise from construction activities may be at a high enough level to delay a feeding attempt or cause avoidance behavior, but noise will not reach the level of causing injury (92 dBA). This project example also assumes that the nest is not in line-of-sight of construction activities. The project biologist should always address the potential for visual disturbance as well.

- **Marbled murrelet –** Suitable murrelet habitat exists about 80 feet from construction activity. In the absence of a survey to protocol, the project biologist must assume that suitable habitat is occupied habitat. By the time noise from construction enters suitable murrelet habitat, levels have attenuated to 93 dBA. This level is above the injury threshold of 92 dBA. At this point, noise levels in suitable habitat would be high enough for injury to occur to any marbled murrelets potentially using the habitat, and an adverse impact would be expected.

7.2 Underwater Noise

In-water work activities contribute to noise in the marine and freshwater environments. Recently, underwater noise from pile driving activities has become an issue of concern to NOAA Fisheries and the U.S. Fish and Wildlife Service (referred to here as the Services). The Services are concerned with recent fish kills that have resulted from in-water pile driving activities in Puget Sound, San Francisco Bay, and British Columbia, Canada. Noise impacts to Essential Fish Habitat (EFH) species should also be addressed. EFH species encompass a diverse group of fish, including ground fish and coastal pelagics.

Noise behaves in much the same way in air and in water. (The information and concepts presented here apply to both fresh and saltwater environments.) Water currents bend sound waves upward when propagated into the current and downward downstream. Sound waves bend towards colder denser water. Bottom topography and underwater structures can block or refract sound waves.

Underwater sound levels are measured with a hydrophone, or underwater microphone, which converts sound pressure to voltage, which is then converted back to pressure, expressed in pascals (Pa), pounds per square inch (psi), or decibels (dB).[34] Several descriptors are used to describe underwater noise. Two common descriptors are the instantaneous peak sound pressure level (dBPEAK) and the Root Mean Square (dBRMS) pressure level during the impulse, which are sometimes referred to as the peak and RMS level respectively. The peak pressure is the instantaneous maximum or minimum overpressure observed during each pulse and can be

34. Measurements are typically recorded electronically for analysis later. Pascals, or psi, can easily be converted to decibels (dB). To convert sound pressure energy to dB in air or water we use the same formula:

$$dB = 20 \log(p/pref)$$

Where dB is decibels, p is the pressure in micropascals (pascal multiplied by 106), pref is a reference pressure. When converting air pressure levels a reference pressure of 20 micropascals is used. The 20 micropascal reference for sound in human studies was selected because it is near the threshold of hearing at 1kHz for the average young person. When converting underwater pressure levels a somewhat arbitrary reference pressure of 1 micropascal is used. Thus in many reports in the literature, underwater decibels are reported as decibels re: 1 micropascal, indicating that the decibels are referenced to 1 micropascal. All underwater sound pressure levels given in this chapter are in decibels (dB) referenced to 1 micropascal (μPa).

presented in Pascals (Pa) or SPL in decibels (dB) referenced to a pressure of 1 micropascal (Pa). The RMS level is the square root of the energy divided by the impulse duration. This level, presented in dB re: 1 Pa, is the mean square pressure level of the pulse. It has been used by NMFS in criteria for judging impacts to marine mammals from underwater impulse-type sounds. The majority of literature uses peak sound pressures (dBPEAK) to evaluate injuries to fish. However, in many instances, it is not clear whether the reported pressure is peak or RMS.

It is not possible to convert peak levels to RMS levels, but a conservative rule of thumb can be applied to use in noise assessments. Peak levels are generally 10 – 15 dB higher than RMS levels. To convert from peak to RMS, subtract 10 dB. This likely overestimates the RMS value, but enables the assessment to remain as conservative as possible. Likewise, to convert from RMS to peak, add 20 dB. This again may overestimate the actual peak sound level, but will provide a conservative estimate.

Sound Exposure Level (SEL) is often used as a metric for acoustic events and is often used as an indication of the energy dose. SEL is calculated by summing the cumulative pressure squared (p^2), integrating over time, and normalizing to one second. This metric accounts for both negative and positive pressures because p^2 is positive for both and both are treated equally in the cumulative sum of p^2 (Hastings and Popper, 2005). The units for SEL are dB re: 1 μPa^2-sec.

Sound levels measured in air are typically used to assess impacts on humans and thus are weighted (A-weighting) to correspond to the same frequency range that humans hear. Sound levels underwater are not weighted and thus measure the entire frequency range of interest, which may extend below and above audible range of many fish.

7.2.1 Noise Generation, Transmission, and Reduction

Transmission loss (TL) underwater is the accumulated decrease in acoustic intensity as an acoustic pressure wave propagates outwards from a source. The intensity of the source is reduced with increasing distance due to spreading. Spreading can be categorized into two models, spherical spreading and cylindrical spreading models.

7.2.1.1 Transmission Loss Calculations for Underwater Noise Levels

Spherical (free-field) spreading occurs when the source is free to expand with no refraction or reflection from boundaries (e.g., the sediment or water surface). The TL for spherical spreading is defined by the formula:

$$TL = 20 \log(R)$$

where R is the range or distance from the source. Spherical spreading results in a general 6 dB decrease in the intensity of the sound per doubling of distance.

Cylindrical spreading applies when sound energy spreads outwards in a cylindrical fashion bounded by the sediment and water surface. Cylindrical spreading is defined by the formula:

$$TL = 10 \log(R)$$

This results generally in 3 dB per doubling of distance transmission loss of underwater sound. However sound in shallow water, where many construction projects exist, reflections from the sediment or water surface can reduce spreading considerably. Because of the complexity of these reflections it is difficult to define. Since sound energy is not perfectly contained by reflection and refraction most experts agree that the true spreading is often somewhere between 3 and 6 dB per doubling of distance, or approximately 4.5 dB per doubling of distance (Vagle 2003).

Currently, the Services are using a practical spreading loss calculation as described by Davidson (<http://freespace.virgin.net/mark.davidson3/TL/TL.html>), where:

$$TL = 15\text{Log}(R_1/R_2)$$

This calculation assumes that sound energy decreases at a rate of 4.5 dB per doubling of distance, which is in between the spherical (6 dB) and cylindrical (3 dB) calculations.

Illingworth and Rodkin (personal communication) state that the underlying characteristic of transmission loss for pile driving in marine environments is spherical spreading, however, like propagation in air, a number of other factors, such as temperature gradients and currents, modify this characteristic. The common occurrence of decreasing temperature with depth can create significant shadow zones (sound refracts or bends towards the colder deeper water as it does in air) where the sound pressure level can be as much as 30 dB lower than that given by spherical spreading. In shallow water (less than 200 meters depth), reflections from the surface and bottom combine in such a way that the sound level transitions from spherical spreading of 6 dB per doubling of distance to cylindrical spreading at 3 dB per doubling of distance. Where this transition occurs depends on the distance from the source, water depth, acoustic wavelength, and the reflective properties of the bottom and surface conditions. Thus, underwater sound propagation has a large amount of uncertainty.

Nedwell and Edwards (2002) measured underwater sound levels between 2 and 652 meters from the piles in the River Arun, England. The authors used the peak-to-peak values collected for each pile to estimate the transmission loss at their measurement site. The transmission loss was estimated to be 0.07 dB per meter.

The authors found that the standard geometric transmission loss formula did not fit well to the data. Therefore, because the losses are mainly due to absorption a better fit is given by the formula below. SL is the source sound level measured at some distance from the pile, N_a is the transmission loss rate or 0.07 dB per meter, and R is the range or distance from the pile in meters.

$$SPL = SL - N_a\,(R)$$

Nedwell et al. (2003) measured underwater sound levels generated from 20-inch and 36-inch steel piles at a ferry terminal project in Southampton England, similar to conditions found in

Puget Sound. Sound levels were monitored 96.3, 233.8, and 417.4 meters from the piles simultaneously. The authors used the peak-to-peak values collected for each pile to estimate the transmission loss at their measurement site. The transmission loss rate was estimated to be 0.15 dB per meter (Figure 7-5). The reason this transmission loss rate was approximately twice as high as the previous study (Nedwell and Edwards 2002) could be due to differences in sediment type, density gradients between fresh and salt water in the estuary, existing piles shielding the sound, or tidal or river currents in the River Arun influencing sound propagation. However, without further study it is unclear why the differences exist.

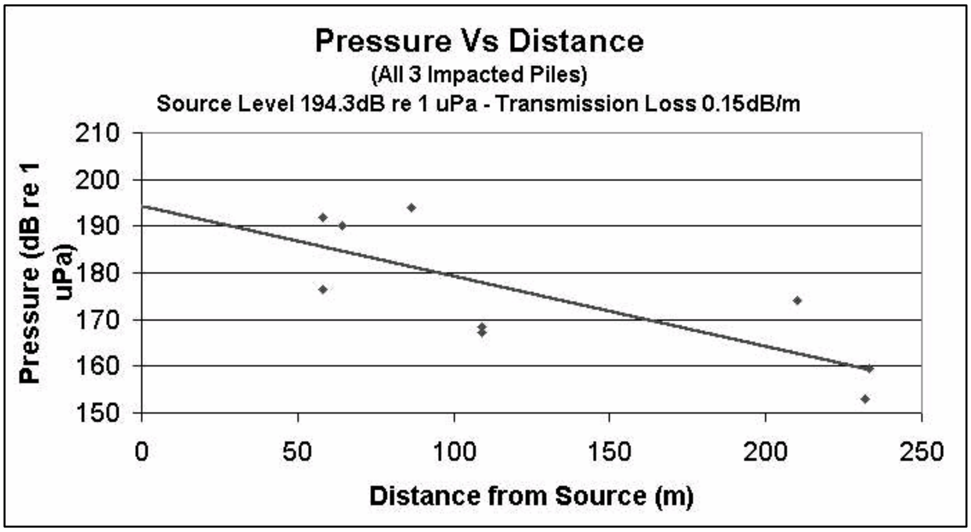


Figure 7-5. Sound transmission loss over distance.
Source: Nedwell et al. (2003).

Rearranging the terms to determine the distance in meters at which the sound levels drop off to ambient levels (action area), the following formula can be used.

$$R = \frac{SL - SPL}{N_a}$$

SL is the sound level at the source (dB), SPL is the ambient sound level (dB), and either 0.07 dB per meter (in river systems; Nedwell and Edwards 2002) or 0.15 dB per meter (in marine environments; Nedwell et al. 2003) can be used for N_a.

7.2.1.2 Noise Reduction Factors

Hydrographic Conditions that Affect Sound Transmission

In a current or tidal flux, sound propagated into the current would be refracted toward the surface where it would be quickly attenuated. However, this would depend on the velocity of the current and would occur on a scale of several hundred feet or more. This has not been researched adequately to make definitive determinations.

The water depth in which frequencies propagate must be greater than one-quarter the wavelength or $h = \lambda/4$ where h = water depth and λ = wavelength (Urick 1983). Wavelength is determined by $\lambda = c/f$ where f = frequency in Hz and c = speed of sound in water (approximately 5000 feet/sec). Since the dominant frequencies generated in pile driving are between 50 and 1000 Hz, most of the energy is not propagated in water depths of 0.4 meters (1.3 feet) or less. However, some sound propagates through the sediment, especially the harder sediments, such as clay and rock, escaping into the water column somewhere else (albeit at a lower level than the source) through *sound flanking*.[35] Sound flanking is a common occurrence and has been observed by Burgess and Blackwell (2003) and WSDOT (2004d).

Bottom Topography

The method of determining how sound spreads as it moves away from the source can be difficult and site specific. It is dependent on sediment types, bottom topography, structures in the water, slope of bottom, temperature gradients, currents, and wave height. In the Puget Sound region, the sediments are relatively soft and the bottom slopes away from the shore relatively quickly. Depending on location and season, there can also be a relatively strong tidal flux in Puget Sound. Therefore, it is clear that general conclusions about spreading cannot be drawn without the likelihood of violating some of the site-specific assumptions listed above.

7.2.2 Baseline Underwater Noise Conditions

Existing underwater noise levels can serve as a baseline from which to measure potential disturbance impacts associated with project activities. Both environmental or natural noise sources and mechanical or human generated noise contribute to the baseline or ambient noise conditions of a project site.

7.2.2.1 Environmental Noise

Ambient noise levels in Puget Sound are typically around 130 dB_{peak} (Laughlin 2005). Carlson et al. (2005)[36] measured the underwater baseline for the Hood Canal to range from 115 to 135 dB_{RMS}. Heathershaw et al. (2001) reported open-ocean ambient noise levels to be between 74 and 100 dB_{peak} off the coast of central California with a sea state of 3-5.

There are numerous contributing sources to baseline noise conditions. Noise levels produced by natural sources include snapping shrimp (71 dB) (Urick 1983), lightning strikes (260 dB), and waves breaking on the ocean surface.

35. *Sound flanking* refers to paths by which sound travels around an element, such as in water surrounding a piling. For example, a sound generated by pile driving can be flanked to another location by the ocean floor if the substrate is relatively uniform and uninterrupted from one location to another.

36. Carlson, T.J., D.A. Woodruff, G.E. Johnson, N.P. Kohn, G.R. Plosky, M.A. Weiland, J.A. Southard, and S.L. Southard. 2005. Hydroacoustic Measurements During Pile Driving at the Hood Canal Bridge, September through November. 2004. Battelle Marine Sciences Laboratory, Sequim, Washington.

7.2.2.2 Mechanical Noise

Ambient noise levels can range louder in areas of high human usage. Feist et al. (1992) measured ambient levels at Everett Home Port to be between 80 and 90 dB (SPL), however the author did not specify if these were peak or rms values. Anchor Environmental (McKenzie personal communication) measured ambient levels at the Mukilteo ferry terminal to be approximately 145 dB peak in the absence of ferry traffic. Ambient underwater noise levels were measured in the vicinity of the Friday Harbor Ferry Terminal project (WSDOT 2005c). Ambient noise levels with no construction activity ranged between 131 dB_{peak} and 136 dB_{peak}. With construction activity (excluding pile driving) the ambient underwater noise levels ranged between 133 dB_{peak} and 140 dB_{peak}. Greene (2003) measured ambient sounds in the Duwamish River averaged over 20 seconds to 5 minutes and varied between 110 to 130 dB (SPL). These values are an average over time and do not specify peak or RMS.

Noise levels produced by human or mechanical sources include large tankers and naval ship engines (up to 198 dB) and 180+ dB for depth sounders (CRS Report 95-603, 1995; Heathershaw et al. 2001). Commercial sonar devices operate in a frequency range of 15 kHz to 200 kHz and in an acoustical range of 150 to 215 dB (Stocker 2002). These levels are maximum source levels.

7.2.3 Underwater Construction Noise

Although there are many sources of noise in the underwater environment, the most common sources of noise associated with construction activities are impact hammers. Underwater noise from pile driving is generated using different types and diameters of piles, types of hammers, and by driving the piles into different types of substrates. Each configuration can produce different sound levels and waveform characteristics.

Sound generated by impact pile driving is impulsive in nature. Impulsive sounds have short duration and consist of a broad range of frequencies. Impulsive waveforms are characterized by a rapid pressure rise time (the time in milliseconds it takes the wave form to rise from 10 percent to 90 percent of its highest peak) that occurs within the first few milliseconds followed by rapid fluctuation (underpressure and overpressure) about the ambient pressure.[37] Although other methods such as peak-to-peak or zero-to-peak are used by some researchers to define rise time the method of calculating rise time noted above has become the standard for pile driving waveforms.

37. The total duration of the impulse varies based on several factors, which include the force applied to the pile, the nature of the pile (i.e., wood, concrete, or steel as well as diameter) and the substrate into which the pile is being driven. In general, most of the energy associated with each impulse occurs within the first 30 to 50 milliseconds. Recent measurements of underwater sound generated by impact pile driving have shown that most of the energy is contained in a frequency range between approximately 25Hz and 1.6 kHz. Within this frequency band the highest energy densities are found between 50 and 350 Hz (Reyff et al. 2002).

7.2.3.1 Impact Equipment

There are five pile driving hammer types that are commonly used. Vibratory hammer, diesel hammer, air or steam hammer, hydraulic hammer, and drop hammer used for smaller timber piles. Wave forms generated by each of these hammer types are described below.

Vibratory hammers vibrate the pile into the sediment by use of an oscillating hammer placed on top of the pile. The vibratory action causes the sediment surrounding the pile to liquefy and the pile can be driven through the sediment. In most cases piles can be driven by vibratory hammers to a depth where they can reach load bearing capacity, but the bearing capacity must be tested with the use of an impact hammer. This is referred to as proofing. To proof a pile it is struck with an impact hammer until the bearing capacity can be measured. This may take seconds or last several minutes depending on site-specific characteristics.

Peak sound levels can exceed 180 dB; however, the rise time is relatively slow (Figure 7-6). Vibratory driving sound levels are generally 10 to 20 dB lower than impact hammer driving.

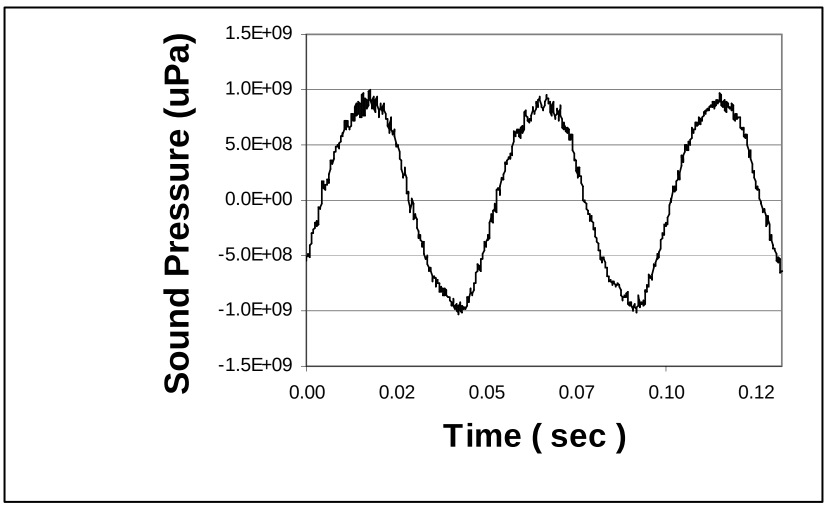


Figure 7-6. Typical vibratory hammer wave form.

Impacts on fish have not been observed in association with vibratory hammers. This is because of the slower rise time and the fact that the energy produced is spread out over the time it takes to drive the pile. As a result, vibratory driving of piles is generally considered less harmful to aquatic organisms and is generally the preferred method.

Air or steam-driven impact hammers use air to lift a heavy piston and then use gravity to drop the piston onto the top of the pile. The height of the piston can be varied somewhat allowing more potential energy to be put into the piston and then transferred as kinetic energy into the pile. Air hammers produce underwater sound waveforms with each pile strike that are similar to diesel hammers (Figure 7-7). Therefore, sound levels and rise time are similar for air hammers and diesel hammers.

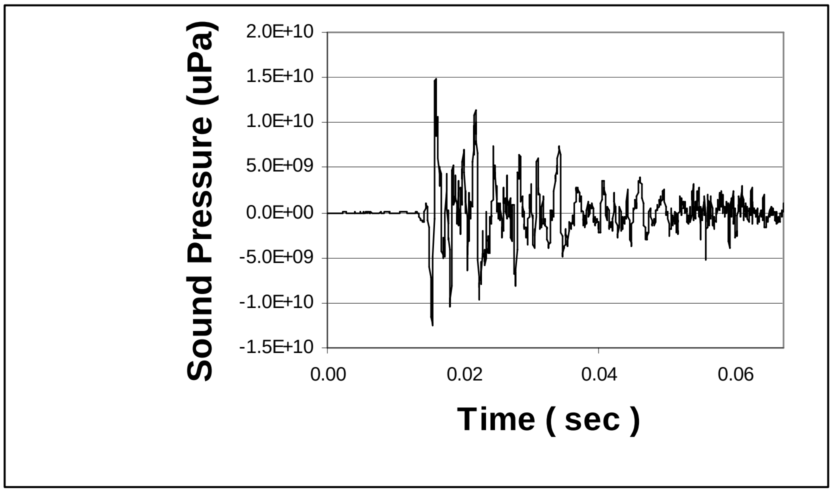


Figure 7-7. Typical air hammer wave form for a single pile strike.

Diesel-driven impact hammers ignite diesel fuel to lift a heavy piston and then use gravity to drop the piston onto the top of the pile. The height of the piston can be varied somewhat by varying the amount of diesel fuel going into the combustion chamber. Diesel hammers produce underwater sound waveforms with each pile strike that are similar to air hammers (Figure 7-8).

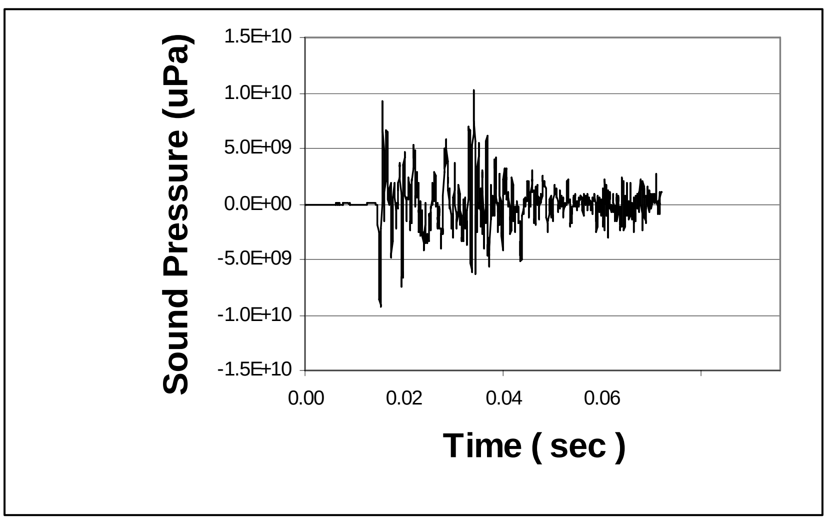


Figure 7-8. Typical diesel hammer wave form for a single pile strike.

Hydraulic driven impact hammers use hydraulics to lift a heavy piston and then use gravity to drop the piston onto the top of the pile. In addition, with some hydraulic hammers, hydraulic pressure is used to drive the hammer into the pile instead of using gravity. Hydraulic hammers produce a somewhat different waveform signature with a much more rapid rise time (Figure 7-9). The diesel hammer was the recommended hammer to use based on data gathered from the Friday Harbor Ferry Terminal Study where rise time was a consideration in the recommendation.

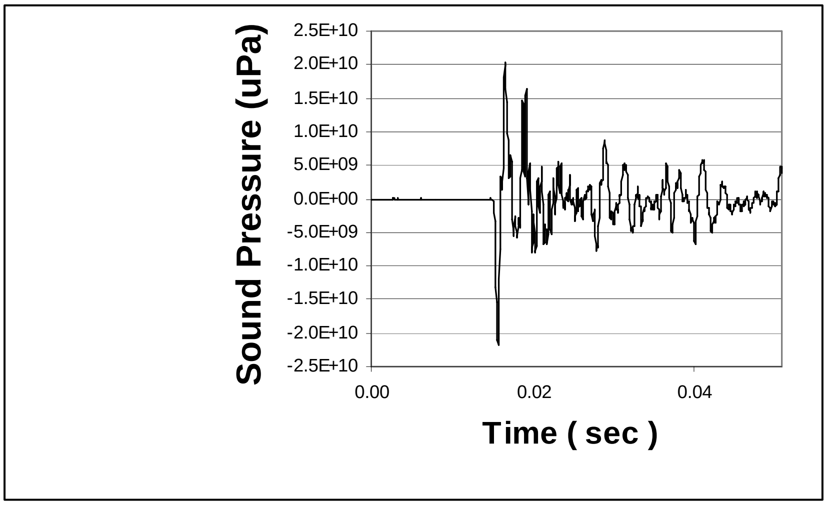


Figure 7-9. Typical hydraulic hammer wave form for a single pile strike.

7.2.3.2 Different Pile Types

Different types and diameters of piles can also affect the noise generated by pile-driving activities. There are three different materials piles can be made of timber, concrete, and steel. Noise levels associated with each of these types of piles are summarized in the list below. These are denoted as either peak or RMS, and show the distance measured, if known:

- Wood piles:[38] 177 dB_{PEAK} @ 10m; 165 dB_{RMS} @ 10m
- Concrete piles:[39] 188 dB_{PEAK} @ 10m; 173 dB_{RMS} @ 10m
- Steel H-piles: 190 dB_{PEAK} @10m; 175 dB_{RMS} @ 10m

38. Timber piles, 12-inches in diameter, have been measured underwater by Illingworth and Rodkin (2004) in California to achieve a peak level of 177 dB. Illingworth and Rodkin have compared the shape of the sound wave between steel piles and timber piles and found that the timber pile produced a more ‘rounded’ wave than with steel piles. This means that although the peak sound levels may be similar the waveform appears more stretched out than for steel piles and the rise time is relatively slower. A slower rise time means that the shock wave produced with each pile strike is not as severe presumably resulting in less damage to the fish. The effect is similar to the difference between a push and a punch.

39. Concrete piles with 24-inch diameter have been measured by POV, and sound levels range between 190 and 205 dB (DesJardin 2003 personal communication). In California, although there have been no documented fish kills with the installation of concrete piles, the Services have not exempted concrete piles from possible sound mitigation strategies or monitoring because of the lack of formally documented effects (CalTrans 2003 personal communication). The POV achieved a 0-5 dB reduction with a bubble curtain on a 24-inch concrete pile (DesJardin 2003 personal communication). The POV has compared the shape of the sound wave between steel piles and concrete piles and found that the concrete piles produced a more rounded wave than the steel piles.

- 12-inch steel piles: 190 dB_{PEAK} @10m[40]; 190 dB_{RMS} @ 10m[41]
- 14-inch steel piles: 195 dB_{PEAK} @ 30m[42]; 180 dB_{RMS} @ 30m[8]
- 16-inch steel piles[43]: 198 dB_{PEAK}@ 10m; 187 dB_{RMS} @ 9m
- 24-inch steel piles[44]: 217 dB_{PEAK} @10m[12]; 203 dB_{RMS} @ 10m
- 30-inch steel piles[45]: 208 dB_{PEAK} @ 10m; 192 dB_{RMS} @10m
- 66-inch dia. steel piles[12]: 210 dB_{PEAK} @ 10m; 195 dB_{RMS} @ 10m
- 96-inch dia. steel piles[12]: 220 dB_{PEAK} @ 10m; 205 dB_{RMS} @ 10m
- 126-inch dia. steel piles: 191 dB_{PEAK} @ 11m; 180-206 dB_{RMS} @ 11m
- 150-inch dia. steel piles[46]: 200 dB_{PEAK} @ 100m; 185 dB_{RMS} @ 100m
- Peak levels are generally 10 to 15 dB higher than RMS levels
- Peak pressures occur between 1 millisecond (msec) very close to the pile and 5 to 6 msec after the strike at a distance of 20 meters from the pile
- The greater the pile surface exposed under the water, the more acoustic energy radiates. Shallower water (e.g., water less than about 3 feet deep) does not propagate sound energy effectively, especially at lower frequencies (Urick 1983).

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40. Illingworth and Rodkin (2002).

41. CalTrans (2003 personal communication) has measured the sound energy emanating from driving 12-inch diameter steel piles to range between 180 – 190 dB, and 14-inch diameter steel piles to range between 195 and 200 dB. Illingworth and Rodkin (2004 personal communication) measured 10-inch steel H-piles in a slough approximately 6 feet deep at 10 meter distance from the pile to range between 180 – 195 dB (160-177 dB RMS). They also measured 10-inch steel H-pile at Noyo Bridge with peak levels at 180 dB (165 dB RMS) at 30 meters from the pile. An H-pile driven on shore next to the water produced peak levels in the water of 170-175 dB (155-162 dB RMS) at 23 meters from the pile. The measurements at Noyo Bridge were highly variable due to the shallow water. Vibratory driving has been shown to be 10 – 20 dB lower than impact driving steel piles of similar diameter (CalTrans 2003 personal communication).

42.. Reyff (2003).

43. Laughlin, Jim. 2004. Underwater Sound Levels Associated with the Construction of the SR 240 Bridge on the Yakima River at Richland. WSDOT, Office of Air Quality and Noise, Seattle, WA. September 2004. 33 pages.

44. Sound pressure levels generated from pile driving of 24-inch diameter steel piles have been measured by POV to range between 201 – 214 dBpeak, and 36-inch steel piles at approximately 224 dBpeak (DesJardin 2003 personal communication). The highest sound pressure levels were observed at a range of 4-5 meters from the pile and the sound pressure level was found to depend most on the type of substrate. They found that sound levels would range between 201 dBpeak to 214 dBpeak within a 2-foot change in substrate depth of the pile due to change in substrate composition. POV also recorded peak pressure measurements at the bottom and 5-7 meters from the water surface. In Canada, there are currently no mitigation or monitoring requirements for steel piling less than 18-inches in diameter as they assume there will be no impacts. The Canadian government has agreed on a 30 kPa (210 dB) threshold for piles larger than 18-inches to protect small fish (DesJardin 2003 personal communication).

45. Hastings and Popper (2005).

46. Reyff (2003).

7.2.3.3 Noise Reduction Strategies

Various measures have been developed to reduce underwater noise generated by pile driving. These are air bubble curtains (confined or unconfined), fabric barriers, and isolated piles or cofferdams. An air bubble curtain is a device used during pile driving that infuses the area surrounding piles with air, thereby generating a bubble screen. The purpose is to reduce peak underwater sound pressure levels (SPLs), which may adversely affect fish, marine mammals, and seabirds in the marine environment.

The components of a bubble curtain typically include a high volume air compressor, primary and secondary feed lines, and air distribution manifolds. Longmuir and Lively (2001) recommended that manifolds should have 1/16-inch air release holes every ¾-inch along their entire length (Figure 7-10). The Services currently recommend basing bubble curtain design on that described in Longmuir and Lively (2001). The air distribution manifolds are placed surrounding the piling below the water surface where the pile meets the sediment. An effective bubble curtain system should distribute air bubbles that completely surround the perimeter of a pile to the full depth of the water column. Reducing the size of the bubbles greatly enhances the sound attenuation of the bubble curtain (Vagle 2003).

In areas where currents exist, where the seafloor or substrate is not level, or piles are being driven at an angle other than 90 degrees to the water surface, the size or number of manifolds should increase to provide coverage throughout the water column. In some of these cases, unconfined bubble curtains may prove ineffective, and a confined system may be required.

The design of an air bubble curtain directly relates to the effectiveness at reducing sound pressure levels. Curtains should be designed to maximize the potential for noise reduction. Studies on the effectiveness of bubble curtains for reducing sound pressure waves have found varied results. Reyff (2003) reviewed previous reports, and also conducted an additional study on the use of bubble curtains and their reduction of sound pressure waves. In previous studies, Reyff (2003) found that bubble curtains resulted in a 0 to 10 dB reduction in RMS. While monitoring pile driving of three large piles (inside diameter of 8 feet, outside diameter of 8.5 feet), bubble curtains reduced peak pressures from 6 to over 20 dB and RMS values from 3 to 10 dB. Thorson and Reyff (2004) found similar results with a reduction of 5 to 20 dB in peak SPLs. Vagle (2003) studied the underwater effects of pile driving at four locations in Canada. This study reported reductions of between 18 dB and 30 dB when using a properly designed bubble curtain. Proper design and implementation is the key factor in bubble curtain effectiveness.

Reyff et al. (2002) evaluated the effectiveness of an isolated pile (IP) technique using a confined bubble curtain system. The IP was 3.8 meters in diameter with the interior coated with 2.54 centimeter closed cell foam. In this type of bubble curtain system, the IP surrounds the actual driven pile, and contains the bubble flow. The IP and bubble curtain system provided a dramatic reduction in both peak pressures and RMS levels. Peak pressures were reduced by 23 to 24 dB and RMS levels were reduced by 22 to 28 dB. Most of the reduction in sound energy occurred at frequencies above 100 Hz.

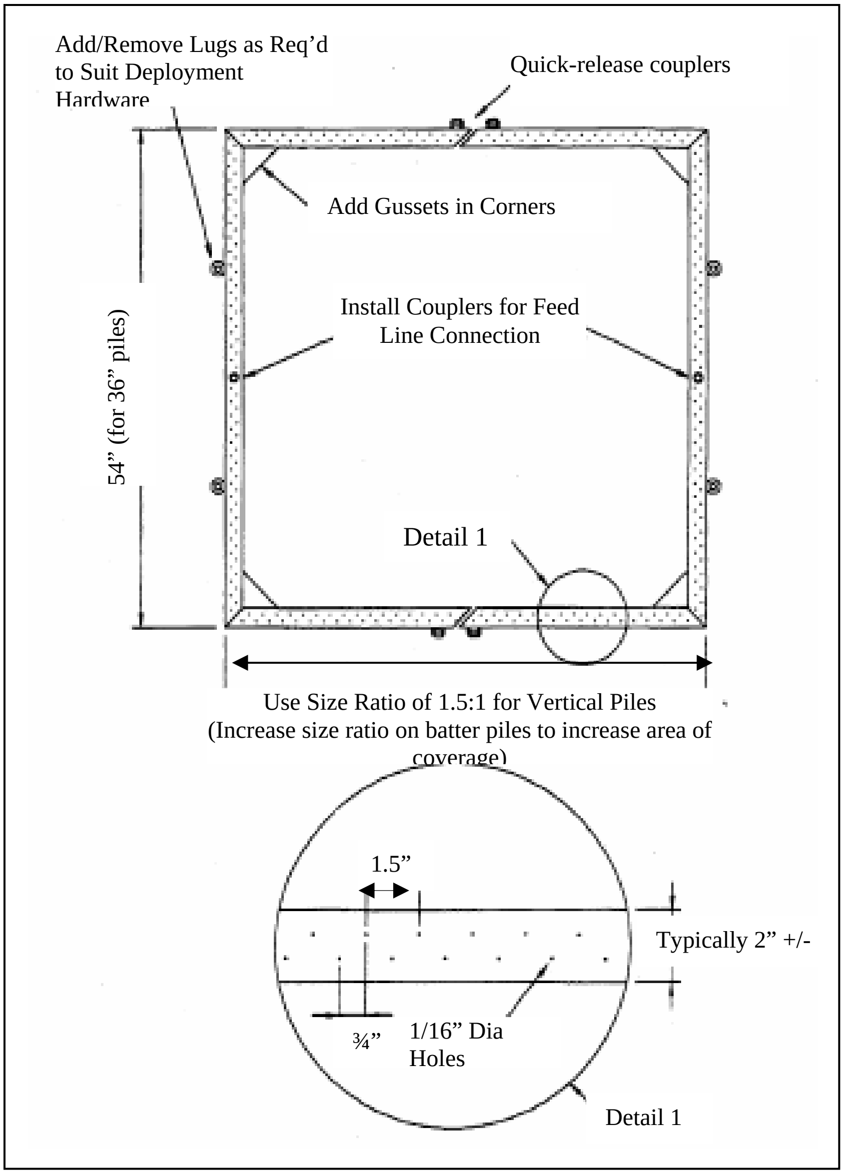

Figure 7-10. Air manifold design.
Source: Longmuir et al (2001).

Fabric barriers have also been used to attenuate SPLs from pile driving activities. The theory is somewhat the same as that for an air bubble curtain, in that the goal is to change the local impedance of the water that the sound must travel through. Cofferdams can be used as well, and may be applied either full of water or drained to the mudline. Cofferdams full of water provide only limited attenuation, while dewatered cofferdams may provide the best isolation of the driven pile.[47]

47. Thorson, P. and J.A. Reyff. 2004. Marine mammal and acoustic monitoring for the eastbound structure. San Fransisco – Oakland Bay Bridge East Span Seismic Safety Project. Report submitted for Incidental Harassment Authorization issued November 14, 2003, to Caltrans.

Because of the large variability in the effectiveness of bubble curtains (and fabric barriers), the Services currently assume there will be a 15 dB reduction in peak and RMS values with the use of a bubble curtain. The 15 dB reduction in peak and RMS value is an average reduction based on the wide range of SPL reductions provided in the literature (0 to 30 dBs).

7.2.4 Determining the Extent of Underwater Project-Related Noise

The action area for a project is defined as the extent of the physical, chemical, and biological effects of the action. When considering the extent of the noise element of the action area (i.e., extent of project-related noise), consider the area underwater through which the sound travels until it reaches ambient levels.

7.2.4.1 Steps for Defining the Extent of Project-Related Noise

The following subsection provides instruction on using noise analysis to determine the extent of project-related noise to help define the action area. This is not meant to provide the project biologist with all of the information needed to describe the action area; noise is just one element of the project that must be considered when defining the action area.

A brief example of how one would use the concepts discussed above to define the extent of project-related noise is provided here.

- Assume the simplest situation where sound levels decrease at a rate of 0.07 dB per meter from the source in a freshwater river system (Nedwell and Edwards 2002), or 0.15 dB per meter from the source in a marine environment (Nedwell et al. 2003). Also assume that a typical peak sound level produced by driving a steel pile with a diesel hammer is 195 dB_{RMS} at a distance of 10 meters (33 feet) from the pile. The calculation shows that the sound level drops off to an ambient level of 130 dB_{RMS} at 929 feet (0.2 miles) in a freshwater river system (i.e., 0.07 dB per meter); or at 433 meters (0.1 miles) (i.e., 0.15 dB per meter) in a marine environment such as Puget Sound.

- Calculations used by the Services for determining at what point the project noise becomes indistinguishable from ambient noise assume a 4.5 dB decrease with doubling of distance. At this rate of loss, the sound level from the source described above drops off to 130 dB_{RMS} at 735,741 meters (139 miles). However, common sense would dictate that the sound levels would drop to ambient levels long before it reached 139 miles because there are other noise sources in the environment that can mask noise levels or factors that can attenuate levels more quickly. As mentioned above, temperature gradients, bottom topography, and currents can cause sound levels to attenuate more quickly. Therefore, it is often difficult to accurately determine the extent of noise using a standard geometric spreading model.

- In addition, the use of a bubble curtain can reduce the levels at the source. Assuming a 5 dB reduction at the source described above from use of an air bubble curtain, the distance at which the sound reaches an ambient level (130 dB_{RMS}) is reduced to about 400 meters (0.1 miles) using the formula from Nedwell et al. (2004). In other words, a 5 dB reduction at the source translates into approximately a 7 percent reduction of the noise extent.

The following example will use both the Nedwell model and the Practical Spreading Loss model in use by the Services to illustrate the procedure for determining the extent of project-related noise.

1. **Estimate the equipment noise level for the project**. Though there are many types of equipment potentially used during underwater construction, pile driving is one of the most probable activities in underwater environments and is one of the best understood. To determine the noise levels associated with pile driving determine the hammer type as well as the type of pile being used. Peak decibels associated with different types of piles are listed in the DIFFERENT PILE TYPES section above.

   - ***Example*** *– A 187 dB RMS sound level is estimated 10 meters from the pile, as a result of driving a 30-inch steel pile.*

2. **Estimate the baseline noise level**. Determine if there have been any noise studies in the vicinity of your project that may be able to specifically define ambient underwater noise levels. If not, based on some of the information cited above, you could estimate a reasonable baseline noise level.

   - ***Example*** *– The project takes place in Puget Sound and no noise studies have been completed in the vicinity of the project. However, based on the ambient noise discussion above, and considering the project is located near a busy port, a baseline noise level of 130* dB_{RMS} *is assumed.*

3. **Determine applicable noise reduction factors**. Identify if there are any noise reduction factors that are present either as a result of the physical location of the project (shallow water, confined harbor, soft-bottom substrates, currents, etc.) or impact minimization measures that will be implemented during construction.

   - ***Example –*** *The project site is bordered on the east by shoreline and upland habitats. As a result, underwater noise associated with pile-driving activities will dissipate 100-200 meters to the east of the locations where piles will be installed. To the west shorelines are located 5 miles away. The top of the harbor is located 2 miles* *to the north and the bottom of the harbor is located 2 miles to the south. A bubble curtain will not be used.*

4. **Use the Nedwell Model to determine the extent of project-related noise**.

   - ***Example –*** *Because this example takes place within a harbor, shallow water depths are assumed, with noise intensity decreasing at 0.15 dB per meter****. From above, R = (SL-SPL)/Na.*** *SL is the sound level at the source (dB), SPL is the ambient sound level (dB), and 0.15 dB per meter can be used for N_a (187 – 130)/.15= 380 meters. Therefore, according to the Nedwell model, construction noise will attenuate to ambient levels in open water at 380 meters from the pile.*

5. **Use the Practical Spreading loss model to determine the extent of project-related underwater noise.**

   - ***Example – Now use the same example assumptions and the Practical Spreading Loss model to determine the extent of project-related underwater noise. TL = 15Log(R1/R2), or solved for R1, R1 = ($10^{(TL/15)}$)(R2).*** *R1 is the distance where noise attenuates to ambient levels, R2 is the range of the known sound level, and TL is the amount of spreading loss (known sound level – ambient sound level). ($10^{(187-130/15)}$)(10) =63,096 meters. Therefore, according to the Practical Spreading Loss model, noise would not attenuate to ambient levels in open water for approximately 39 miles. This is likely an invalid distance, and true attenuation to ambient levels likely happens somewhere between these two models. The project biologist should determine where an appropriate extent is located, based on land masses, marine objects, and variances in ambient conditions throughout the environment. For example, a busy shipping lane located near the area may limit the extent of noise.*

   - ***Figure 7-11 maps the extent of the example project.*** *Sound pressure travels in a linear direction (concentrically) away from the source; when the sound intersects a landmass, it is assumed it attenuates to background levels; it should not travel through the land mass or reflect off of the land mass. Any protruding land mass within the aquatic area, in this case the mouth of the harbor, will likely create a "shadowing effect". The actual extent of project-related noise defined by the Practical Spreading Loss model would actually be much further out than shown in the example. The opposite shoreline defines the extent.*

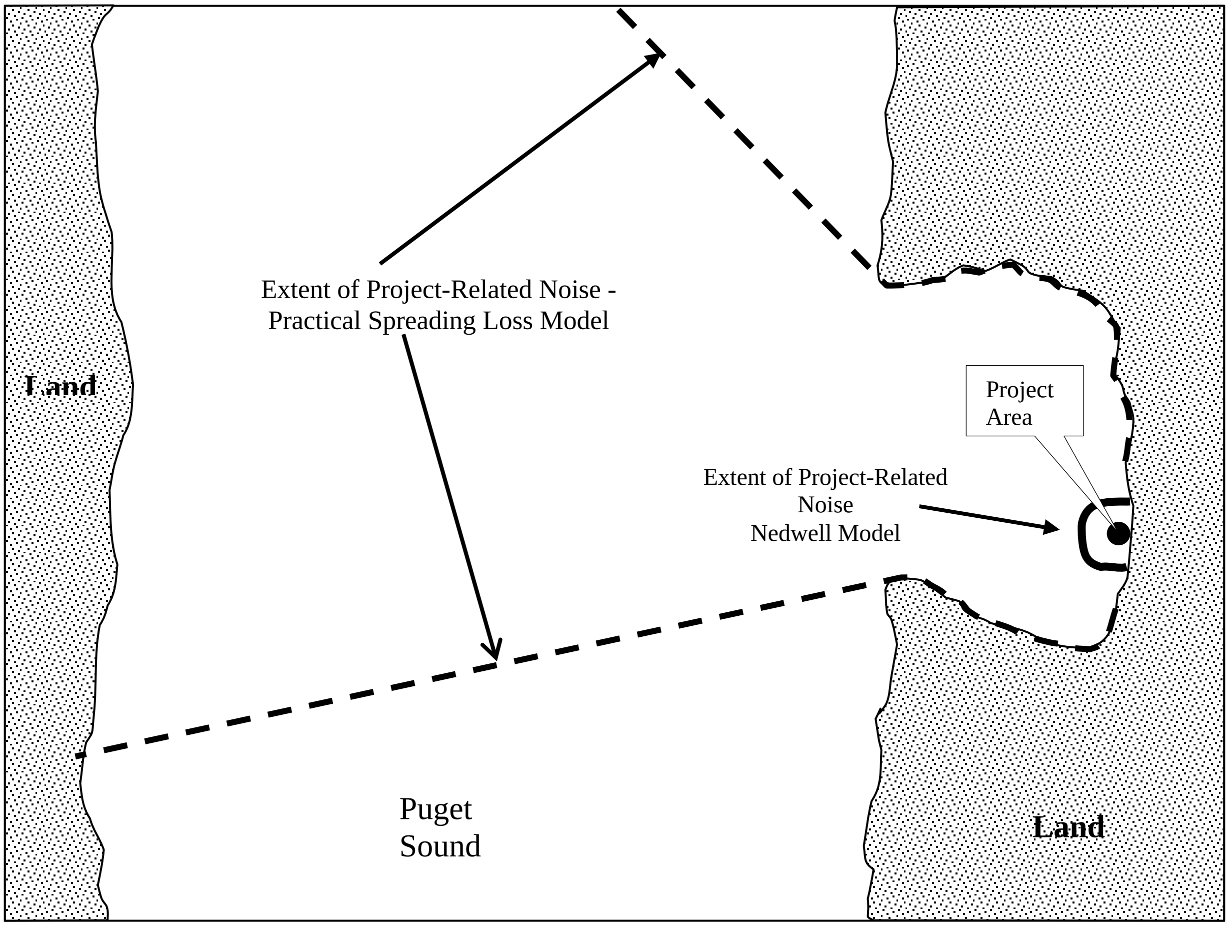

Figure 7-11. Example: Extent of Project-Related Noise

This figure shows the extent of project-related noise for the example project above. The dashed line represents the Practical Spreading Loss Model, and the solid line indicates the Nedwell extent.

7.2.5 Species and Noise

As is stated in the first section of this chapter, one task the project biologist must complete is identifying and measuring noise to determine the noise element of the action area. Another task the project biologist must complete is analyzing the effects of noise on the species that are addressed in the BA.

7.2.5.1 How Aquatic Species Hear

The main sensory organ in fish is the lateral-line system that detects low-frequency (<100 Hz) particle motion in water. The lateral-line organ is likely involved in acoustic repulsion when the source is within a few body lengths of the fish. The inner ear located within the skull of the fish is sensitive to vibration rather than sound pressure.[48] In fish species that are hearing specialists, the gas-filled swim bladder acts as a transducer that converts sound pressure waves to vibrations, allowing the fish to detect sound and vibration.

Fish species with a reduced or no swim bladder tend to have a relatively low auditory sensitivity. Fish having a fully functional swim bladder tend to be more sensitive. Fish with a close coupling between the swim bladder and the inner ear are most sensitive.

Most audiograms of fishes indicate a low threshold (higher sensitivity) to sounds within the 100 Hz to 2 kHz range (Stocker 2002) (Figure 7-12).[49] Anderson (1992) suggests that juvenile fish may have less developed hearing abilities so the distance at which they could detect pile driving sounds might be much less than adults. Audiograms developed for various fish species are based on sound pressure. However, fish do not hear with sound pressure. They hear with particle motion. Therefore, the thresholds and frequency ranges listed above and in Figure 7-12 will likely be revised when those data are available.

High-intensity sounds may temporarily or permanently damage the hearing of fish.[50] However, damage to hearing by intense sound depends on auditory threshold and will thus vary from species to species (Popper and Fay 1973, 1993).[51] Popper et al. (unpublished) exposed three species of fish to sounds from a seismic airgun, having sounds similar to pile driving. Peak sound levels ranged between 205 and 209 dB_{PEAK}. They exposed a hearing generalist (broad

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48. Fish have three symmetrically paired structures in the inner ear associated with bony otoliths: the lagena, sacculus, and utriculus. In most species the saccule and lagena detect acoustic pressure and acoustic particle motion (Popper and Fay 1973) and the utricle is involved in sound detection by several species of clupeids and perhaps other species (Popper and Fay 1993).

49. Cod has a hearing threshold of 75-80 dBrms between 100 and 200 Hz (Chapman and Hawkins 1973). Atlantic salmon have a sensitivity of 95 to 100 dBrms between 100 and 200 Hz (Hawkins and Johnstone 1978). Since both species have their best sensitivity between 100 and 200 Hz one would expect to see damage of hair cells in salmon occurring with exposure to continuous sound at about 200 dBrms (Hastings 2002).

50. Popper and Clarke (1976) found that gold fish (*Carassius auratus*) demonstrated up to a 30 dB decrease in hearing sensitivity when exposed to 149 dB for four hours, but hearing returned to normal after 24 hours. Enger (1981) used a sound level of 180 dB to destroy bundles of cilia on the saccular maculae of codfish as evidenced by scanning electron microscopy and assumed permanent hearing loss.

51. Enger (1981) exposed 26 cod (*Gadus morhua*) to continuous tones of 180 dBrms at frequencies from 50 to 400 Hz for 1 to 5 hours and found destruction of auditory hair cells in the saccule. Hastings (1995) found destruction of auditory sensory cells when she and her colleagues exposed goldfish (*Carassius auratus*) to continuous tones of 189, 192, and 204 dBpeak at 250 Hz and found destruction of ciliary bundles correlate with sound pressure level at a 95% confidence level. Hastings et al. (1996) found destruction of sensory cells in the inner ears of Oscars (*Astronotus ocellatus*) 4 days after being exposed to continuous sound for 1 hour at 180 dBpeak and 300 Hz. Fish exposed to 180 dBpeak sounds at 60 Hz either continuous or 20% duty cycle (impulsive) or to 180 dBpeak sounds at 300 Hz and 20% duty cycle for 1 hour had no apparent damage. The authors also found no damage in fish allowed to survive for only 1 day after exposure, suggesting that damage may develop slowly.

Hastings et al. (1996) also examined the sensory cells of the lateral line and semicircular canals of the inner ear in the Oscars and found no damage. The authors speculated that this could be related to the fact that these sensory hair cells do not have an overlying otolith.

McCauley et al. (2003) exposed caged pink snapper (*Pagrus auratus*) to air gun sound levels as the ship passed by the caged fish, producing damaged hair cells that did not regenerate up to 58 days after exposure.

whitefish), a hearing specialist (lake chub), and a species that is intermediate in hearing (northern pike). They found that the hearing generalist had no significant effects from air gun exposure, the lake chub indicated the most effect in temporary threshold shift, and the northern pike showed a significant hearing loss but less than that of the lake chub. Lake chub and northern pike returned to their respective normal thresholds after 18 to 24 hours.

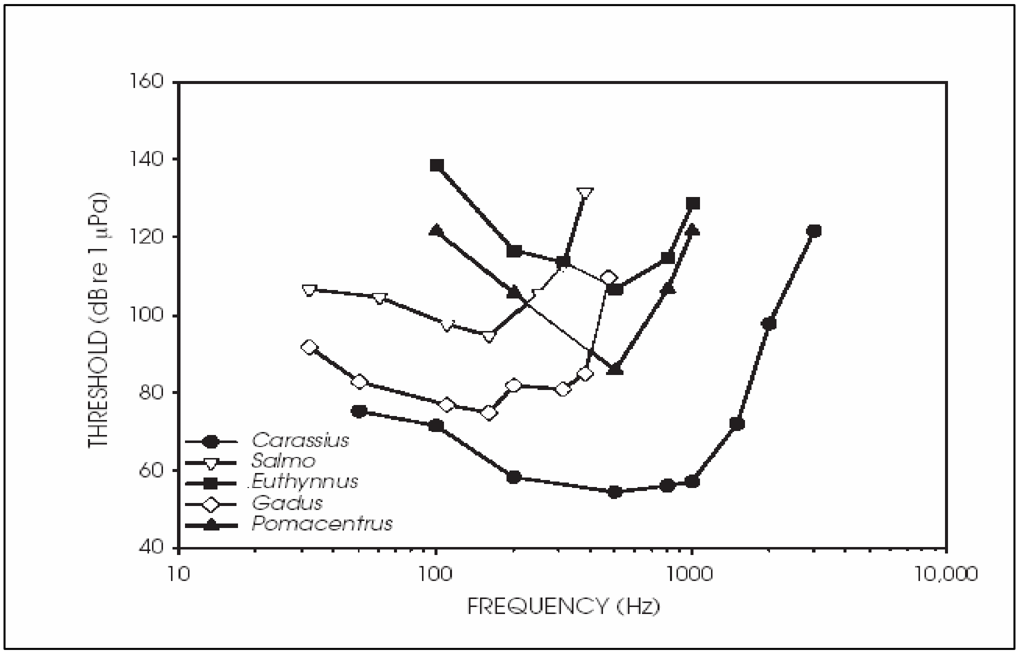


Figure 7-12. Audiogram for several fish species.
Source: Burgess and Blackwell (2003).

One study completed by Feist et al. is particularly pertinent to species potentially occurring in Washington. Feist et al. (1992) looked at the effects of concrete pile driving activities on the behavior and distribution of juvenile pink and chum salmon in Puget Sound. The authors found that juvenile pink and chum salmon (1–2 inches total length) did not change their distance from shore or cease feeding in response to pile driving. However, they did find that there were substantial differences in the distributions and sizes of fish schools on pile-driving days versus non-pile-driving days.

Lethal Impacts Associated with Noise

Risk of injury or mortality for aquatic species and fish associated with noise, in general, is related to the effects of rapid pressure changes, especially on gas filled spaces in the body. Rapid volume changes of the swim bladder may cause it to tear, reducing hearing sensitivity in some hearing specialist species, and loss of hydrostatic control.

According to Hardyniec and Skeen (2005)[52] and Hastings and Popper (2005) the effects of underwater sounds created by pile driving on fish may range from a brief acoustic annoyance to instantaneous lethal injury depending on many factors including:

- Size and force of the hammer
- Distance from the pile
- Depth of the water around the pile
- Depth of the fish in the water column
- Amount of air in the water
- The texture of the surface of the water (amount of waves on the water surface)
- The bottom substrate composition and texture
- Size of the fish
- Species of the fish
- Physical condition of the fish.

Physostomus fishes, such as salmonids, regulate the air in their swim bladders through a direct connection to the esophagus. Salmonids acclimate their swim bladders by gulping air at the surface, and as they swim deeper the swim bladder becomes compressed. When exposed to a sudden positive pressure, or overpressure, the swim bladder compresses further. When exposed to a sudden negative pressure, or underpressure, the swim bladder may expand beyond its original volume at depth but may not suffer or injure any other organs because it has some room to expand. Physostomus fishes acclimated to the surface atmospheric pressure may suffer less injury or mortality the deeper they are in the water column, whereas those acclimated to deeper water pressure may suffer more injury in shallow areas (Carlson 2003 personal communication).

Physoclistus fishes, such as bluegill, regulate air in the swim bladder through the circulatory system. In a physoclistus fish, the swim bladder will roughly maintain its volume at depth. During exposure to underpressure, the swim bladder will expand, possibly tearing and causing damage to other organs. The magnitude of the expansion of the swim bladder is dependent on the magnitude of the underpressure. It is simply an example of Boyle's law: The volume of a confined amount of gas at constant temperature is inversely proportional to the pressure applied to the gas (Carlson 2003 personal communication).

There have been a few studies addressing the effects of pile driving on fish, which are described here, and others are summarized in the footnotes.[53] Illingworth and Rodkin (2001) found that

52. Hardyniec, Sara and Sarah Skeen. 2005. Pile driving and barotraumas effects. J. Transportation Research Board, No. 1941, pp. 184 – 190.

53. Diver observations made by the Port of Vancouver (POV) in Canada following pile driving 36-inch steel piles into sandstone bedrock found higher mortality rates on the bottom than observed on the surface although no counts

there was not only a relationship between distance from the pile but an increase in the degree of damage and number of fish impacted with increasing duration of exposure to pile-driving activities.[54] Illingworth and Rodkin (2001) found that both a smaller hammer size and bubble curtains reduced injuries to fish.[55] In the literature review by Hastings and Popper (2005) they found that the study by Yelverton (1975) using underwater explosives indicated that smaller fish were more likely to be harmed than larger fish during underwater explosions.

Besides permanent hearing damage, exposure to high levels of noise received by marine mammals may cause hemorrhaging around the brain and ear bones (NMFS 2005). Injury or behavioral reactions from intense acoustic exposure, such as naval sonar, may lead to stranding of cetaceans. Information from stranded beaked whales indicates deep diving marine mammals may form embolisms (nitrogen as bubbles) when exposed to intense acoustic exposure during deep dives with unusually quick ascents (Jepson et al. 2003).

Behavioral Impacts Associated with Noise

Mueler et al. (1998)[56] and Knudsen et al. (1992; 1996)[57] found that juvenile salmonids (40 to 60mm length) exhibit a startle response followed by a habituation to low frequency (infrasound) in the 7 to 14 Hz range. Mueler et al. (1998) and Knudsen et al. (1992; 1996) also indicate that

were reported (DesJardin 2003 personal communication). Fish mortalities at the POV included herring, juvenile salmon, rockfish, and tomcod.

Experiments conducted by the Pacific Northwest National Laboratory (PNNL) placed Bluegill in a hyperbaric chamber and acclimated to simulated ambient surface pressures of 101 kilopascals (kPa) in one group and simulating ambient pressures at 30ft depth of 191 kPa in another group inside a hyperbaric chamber. The fish were then exposed to 400 kPa for 30 to 60 seconds then pressure was rapidly decreased to 2 to10 kPa respectively within 0.1 seconds. The fish were then held for 48 hours for observation (Carlson 2003 personal communication). The results for Bluegill indicated 90% injury and 21% mortality to the 30ft acclimated group and 35% injury and 5% mortality to the surface acclimated group (after 48 hours). Carlson (2003 personal communication) found that both acclimation (Pa) and exposure (Pe) pressures are important and the ratio of Pe to Pa is an important predictor to mortality and possible injury. In the example below, it shows the percentage increase in bluegill swim bladder volume during the 0.1 second drop in pressure (Carlson 2003 personal communication). Similar unpublished work has been done with rainbow trout and results indicated no mortality and minimal injury.

54. In one experiment, all fish exposed to driving for one minute were unaffected while 80 percent of fish exposed for six minutes exhibited significant tissue damage. In a second experiment, only fish exposed for 40 minutes or longer were seriously injured.

55. The authors put fish in cages at various distances from 8-foot diameter steel piles, and 60% of fish were found with damage to their internal organs as far as 150 meters (492 feet) from the pile with the large hydraulic hammer (1,700 kJ maximum) and no bubble curtain. With a smaller hydraulic hammer (750 kJ maximum) and a bubble curtain in operation, only 40% were damaged at this distance. In general, they found that the greatest impacts were observed within a 30-meter (98-foot) radius of the pile. It is assumed that there would be a decrease of 3 dB with halving of the hammer energy.

56. Mueller, Robert P., Duane A. Neitzel, William V. Mavros, and Thomas J. Carlson. 1998. Evaluation of low and high frequency sound for enhancing fish screening facilities to protect outmigrating salmonids. U.S. Dept. of Energy, Portland, Oregon. Project number 86-118.

57. Knudsen F.R., P.S. Enger, and O. Sand. 1992. "Awareness reactions and avoidance responses to sound in juvenile Atlantic salmon, *Salmo salar L.*" *Journal of Fish Biology* 40:523-534.

Knudsen F.R., C. Schreck, and S. Knapp. 1996. "Avoidance responses and habituation to low frequency sound in juvenile steelhead and chinook." (Submitted for publication.)

sound intensity level must be 70-80 dB above the hearing threshold at 150 Hz to obtain a behavior response.

According to Feist et al. (1992) broad-band pulsed sound (e.g., pile driving sound) rather than continuous, pure tone sounds are more effective at altering fish behavior.[58] However, the sound level must be at least that of the minimum audible field of the fish for the frequencies of interest (1 to 100 Hz for pile driving), ambient noise should be at least 24 dB less than the minimum audible field of the fish, and the pile driving sound levels had to be 20 to 30 dB higher than ambient sound levels in order to produce a behavioral response (in herring) (Olsen 1969, 1971).

Behavioral sensitivity is lowest in flatfishes that have no swim bladder and also in salmonids (brown trout) in which the swim bladder is present but somewhat remote from the inner ear. Gadoid fishes (cod, whiting) in which the swim bladder is closely associated with the inner ear display a relatively high sensitivity to sound pressure (Turnpenny et al. 1994).

Hastings and Popper (2005) present a summary of different sound levels and effects on fish based on a review of the best available science from the literature that has the most relevance to pile driving. However, the review does not include Pacific Salmon species or bull trout, the species project biologists would need to address in their BAs.

Jorgensen (unpublished) from Fisheries and Oceans Canada recently presented preliminary data suggesting that that sound generated by an air gun at sound levels between 205 and 209 dB_{PEAK} indicated no significant difference in startle response in the vertical direction or vertical velocity and a possible slight difference in the horizontal direction. The author also indicates that the fish observed did not actively avoid the sound, and there appeared to be no hearing loss. The fishes studied included broad whitefish, northern pike, and lake chub.

In addition to lethal impacts, underwater noise may temporarily affect marine mammals in several ways. Marine mammals, like other mammals, can experience a masking effect from noise exposure. Masking occurs when environmental noise is loud enough to cover or mask necessary sounds. However, unlike other mammals and pinnipeds, killer whales echolocate and communicate by pulsed calls, whistles, and clicks. Their highly developed acoustic ability is used for navigation, prey location, and communication. Noise can mask echolocation and

58. Hastings (1995) reported that 13 out of 34 goldfish exposed for 2 hours to pure tones ranging from 192 to 204 dBpeak at either 250 or 500 Hz experienced equilibrium problems including swimming backwards/upside down and wobbling from side to side. These fish recovered within one day, suggesting that the damage was not permanent. These behaviors could have been caused by post-traumatic vertigo similar to that experienced by humans after a severe blow to the body or head.

Hastings (1995), Hult (1982), and Norris and Møhl (1983) found that captive dolphins disorient schooling fish with a series of clicks at times over a two-hour period. Although the sound levels were not measured in these studies. Norris and Møhl (1983) reported that in captivity dolphins usually produce clicks at levels from 140 to 180 dBpeak with peak energy in frequency bands around 1-5 kHz.

Avoidance behavior using pure tones was detected at 128 dB for one fish species (bass) which is 32 dB below the lowest avoidance threshold detected for air gun sounds but comparable with other species when exposed to specially developed deterrent signals (Turnpenny et al. 1994). Low duty cycle air gun sounds generally elicit high avoidance thresholds (approximately 160 dB or higher) while the high duty cycle (100%) acoustic deterrent signals elicit low avoidance thresholds (128 dB or higher).

impede communication necessary for cooperative foraging (Bain and Dahlheim 1994). Masking decreases the area where prey items are detectable by echolocation. Masking is most acute when the noise source is directly in front of killer whales (Bain and Dahlheim 1994; Bain 2002).

7.2.5.2 Threshold Levels

In 2002, Hastings recommended 180 dB_{PEAK} and 150 dB_{RMS} as the thresholds for protecting salmon.[59] The recommendations have been used by the Services in numerous biological opinions. Popper et al. (2006)[60] developed a more conservative interim criteria which proposes the use of a dual criteria using SEL and peak sound pressure levels of 187 dB SEL and 208 dBpeak to be protective of injury to fish. The SEL is based on a single strike rather than on cumulative strikes. The Services have not approved these criteria as of May 2006. Until agreement is reached, the current injury threshold of 180 dB_{PEAK} remains in use.

It is likely that some standard WSDOT pile driving activities using 18-inch or larger steel pile would exceed the 187 dB SEL threshold that Popper et al (2006) are proposing. WSDOT has observed fish kills at some of its pile driving operations but it is uncertain what the actual peak or SEL sound levels were at the time of the kills. Many of the killed fish observed were pile perch.

As mentioned above, the Services currently recognize 180 dB_{PEAK} as the threshold for injury to salmon and bull trout (NOAA/USFWS 2005). They anticipate the potential for barotraumas to occur in salmon and bull trout at SPLs greater than or equal to 180 dB_{PEAK}. The 180 dB_{PEAK} threshold is considered very conservative.

The Services also currently recognize a 150 dB_{RMS} level as the threshold for disturbance to salmon and bull trout. Based on their assessment, sound pressure levels in excess of 150 dB_{RMS} are expected to cause temporary behavioral changes, such as elicitation of a startle response, disruption of feeding, or avoidance of an area. Depending on site specific conditions, project timing, project duration, species life history and other factors, exposure to these levels may cause behavioral changes that rise to the level of “take”. Those levels are not expected to cause direct permanent injury, but may indirectly affect the individual (impairing predator detection, etc). It is important to note that this is a “may affect” threshold, not an adverse affect threshold. Whether or not 150 dB_{RMS} causes takes must take into consideration numerous factors. The USFWS (2004) has also identified underwater threshold sound levels for foraging marbled murrelets. As with bull trout, the injury threshold remains at 180 dB_{PEAK}. The USFWS established the underwater disturbance threshold based on the 92 dB level identified in the Olympic National Forest biological opinion (USDI 2003). It was assumed that murrelet hearing underwater is the same as above water. Therefore, after converting the pressure level to

59. These recommendations were based on long-term exposure to a pure tone.

60. Popper, Arthur N., Thomas J. Carlson, Brandon L. Southall, and Roger L. Gentry. 2006. Interim Criteria for Injury of Fish Exposed to Pile Driving Operations: A White Paper.

underwater sound metrics, the disturbance threshold for underwater murrelet foraging is 153 dB_{RMS}. Whether or not this causes *take* must take into consideration numerous factors as above.

Under the Marine Mammal Protection Act (MMPA), NMFS has defined levels of harassment for marine mammals in general. According to the listing document, levels at which underwater noise negatively impact hearing and behavior are poorly understood for killer whales. If a temporary shift in hearing is experienced from noise exposure, the resulting impairment can continue after the exposure (NMFS 2005). In the MMPA, Level A harassment is defined as "*Any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild.*" Level B harassment is defined as "*Any act of pursuit, torment, or annoyance which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to migration, breathing, nursing, breeding, feeding, or sheltering.*"

NMFS is currently recommending the use of the noise threshold levels for marine mammals as described in the MMPA. The injury threshold is identified as 180 dB_{RMS} for cetaceans (whales) and 190 dB_{RMS} for pinnipeds (sea lions). NMFS states that cetaceans should not be exposed to underwater noise exceeding 180 dB_{RMS} in order to avoid permanent physiological damage to hearing (71 FR 3260). The underwater disturbance threshold for cetaceans is 160 dB_{RMS} for impulse noises and 120dB_{RMS} for non-impulse, continuous, industrial noises. These levels were set based on data on the effects of anthropomorphic noise on grey whale (migration from studies by Malme et al. 1984 [as cited in 71 FR 3260]).

7.2.5.3 Extent of Project-Related Noise and Effect Determinations

The threshold levels established above can be used to define the zone of potential impact for salmon, bull trout, killer whale, and diving marbled murrelets. For example, the zone of impact for injury to these species would occur in the area where project-related noise has not yet attenuated below the injury threshold level. The zone of impact for disturbance would be the area where project-related noise has not yet attenuated to the disturbance threshold. These distances can be calculated by using the Practical Spreading Loss model above, substituting the threshold level for the ambient level to determine the transmission loss.

As mentioned above, the disturbance threshold should be considered the "may affect" threshold. The project effect determination for fish, for example, is not automatically a "not likely to adversely affect" merely because the noise level is above the disturbance threshold but below the injury threshold. Other project conditions, such as timing, duration, or life history information may also be necessary to ensure the effects from noise are insignificant or discountable. Likewise, behavioral disruption could also result in a likely to adversely affect situation if measures cannot be taken to minimize effects.

Even if a species is outside the zone of behavioral disruption (i.e., located below 150 dB for salmon and trout and below 153 dB for murrelet), a *no effect* determination may not be warranted. For a *no effect* determination, the species must be located in a zone where all underwater sound has attenuated to ambient levels.

An important thing to realize when using the threshold levels identified above is that the injury and disturbance thresholds are measured in two different metrics, dB_{PEAK} and dB_{RMS}. When using the models, it is crucial to compare like values to ensure accuracy. For example, a noise level measured in PEAK should not be used to determine the distance of the disturbance threshold, which is measured in RMS. Likewise, using an RMS noise level to identify the injury threshold (PEAK) will lead to incorrect results.

7.2.5.4 Anticipated Project Requirements

The Services have completed recent consultations that have developed reasonable and prudent measures requiring underwater pile driving projects to mitigate for potential impacts. The bulleted statements below summarize what anticipated requirements may be for underwater pile driving projects:

- Vibratory hammers may be required where substrate conditions allow.
- Hydroacoustic monitoring will likely be required on any project with impact pile driving.
- Monitoring will likely be required to determine presence of killer whale and Steller sea lions.
- If the use of a bubble curtain or other attenuation method is not proposed, the Services may require the use of an attenuation method if SPLs exceed the threshold limits for a certain amount of time. For example, pile driving without a bubble curtain may be allowed only if constant monitoring indicates RMS levels exceed 150 dB less than half of the time, and peak levels never exceed 180 dB. If RMS levels exceed 150 dB more than half of the time, and peak values ever exceed the 180 dB threshold, a bubble curtain will likely be required. However, these conditions are site and project-specific.
- The design of any bubble curtain to be used will have to be approved in advance by the Services.
- A report about the hydroacoustic monitoring will have to be submitted to the Services after pile driving is completed.

8.0 Action Area

8.0 Action Area

Chapter Summary

- There is only one action area defined for a project.
- The action area is not determined by the extent of impacts on species and habitat; rather, it is determined by the geographical effects of the action on the environment.
- Each project has only one action area, not separate terrestrial and aquatic action areas.
- The action area should be defined in the Project Action Area section of the BA.
- A map or figure showing the action area should accompany the verbal description of the action area.
- Steps to be completed in order to define the action area are these:

  1. Identify all project impacts.
  2. Determine the geographic extent of each type of project impact in order to define a zone or area of project impacts for each.
  3. Overlay the multiple zones or areas of project impacts in combination to establish the geographic extent of all project impacts.
  4. Define the action area based upon the farthest geographic extent of potential project impacts.

- The action area may include discrete areas where project-related impacts may occur in isolation from the primary area of anticipated project impacts.
- Within the single action area, project biologists may choose to discuss some of the zones of impact previously defined, to facilitate report organization and analysis of effects.

This section provides guidance for defining the limits of the action area. BA excerpts are provided to illustrate how the project biologist can effectively define the limits of the action area.

8.1 Defining the Action Area

The general location of the project action area should be described in the BA. A map, legal description, and photographs (aerial or ground) can help to illustrate the context and extent of the project action area.

A project biologist's first task is to define the specific limits of the project action area. The limits of the action area should be based upon the geographic extent (in both aquatic and terrestrial environments) of the physical, chemical, and biological effects resulting from the proposed action, including direct and indirect effects, as well as effects of interrelated and interdependent activities.

The project biologist should provide clear justification of the action area limits so that BA reviewers can follow the author's line of thought and reasoning. The author should also provide reviewers with enough information to determine the accuracy of the limits defined.

> *Often, project biologists incorrectly identify the action area. The action area should be based on how far all effects of the action reach, not simply how far the impacts related to project equipment extend.*
>
> *For example, if an effect of an action (e.g., dewatering) can be detected 150 miles downstream of the project area, the entire 150 mile stretch of river would be included in the action area, as defined by the project.*

Defining the geographic extent of potential effects is often difficult. For example, delineating the limit of noise impacts, or determining how far noise will travel from a specific location before attenuating to background levels, can be speculative. For noise impacts in terrestrial areas, commonly accepted thresholds are often used (e.g., a 1-mile radius for pile driving activities). However these thresholds should be refined based upon an analysis of site-specific ambient noise levels and the predicted distance noise levels will travel before attenuating to ambient conditions. The geographic extent of project-related noise underwater can extend well beyond the radius defined for terrestrial impacts, depending upon surrounding bathymetry, water temperature, and other factors (see PART 2, NOISE IMPACT ASSESSMENT for more detailed information on analyzing noise impacts).

Estimating the maximum downstream distance through which sediment or pollutants can affect water quality also may be speculative. One approach uses the Ecology mixing zone distances that apply to many projects. Whatever the approach, a sound rationale—and, if possible, documented support for the limits—must be demonstrated.

Each project has just one action area, which is usually larger than the project site or footprint. The single action area for the project encompasses the extent of all direct and indirect effects related to the proposed action (as well as interdependent or interrelated activities) affecting both aquatic and terrestrial environments. In some situations it may be necessary to define a very large action area to address all project-related effects. The number of species addressed in a BA or occurring in the vicinity of a project plays no part in defining the action area for the project.

Action areas in aquatic environments are three-dimensional, encompassing impacts above and below the water surface. Often the underwater portion of the action area has a size and shape different from the portion of the action area located above water.

To define the project action area, a project biologist should complete the following steps.

1. ***Identify all potential project effects***.
   This includes all direct and indirect effects, as well as those effects associated with interrelated and interdependent activities, occurring within both aquatic and terrestrial environments.

2. ***Determine zones of effect for each type of project effect***.
   Look at each type of project-related environmental effect (i.e., in-water sedimentation, terrestrial noise, underwater noise, clearing and grading, induced development, traffic, etc.) separately to determine its geographic extent.

3. ***Determine the geographic extent of all project effects***.
   Once the project biologist has identified zones representing the geographic extent of each type of project-related environmental effect, these zones can be combined to form a single representation of the geographic extent of all project effects.

4. ***Define the action area***.
   The action area is defined by the outermost extent of all of the zones of effect combined. The outer limits of the action area may be defined by the zone of effect identified for one type of project effect that extends farther than any other, or the limits of the action area may be defined by a combination of multiple zones of effect. In some instances there may be discrete areas affected by project activities that are not contiguous with the other zones of effect (for example, an offsite mitigation area). In these cases, the isolated area affected by project-related activities need not be physically lumped into the action area but can be considered a separate component of the action area.

8.1.1 Example of Process for Defining Action Area

This section provides two examples of how the action area for a project is defined. The first example shows how an action area is determined based upon the zones of impact defined for multiple project elements. The second example illustrates how an action area is defined in an aquatic environment, based upon anticipated noise impacts above and below the water.

The first example illustrates how the overall action area for a project is composed of the combination of multiple zones of effect that reflect potential impacts associated with each project element. In this example, the action area is defined based on the extent of project-related noise and the extent of project-related aquatic effects. The proposed project consists of roadway widening and replacement of a culvert. Figures 8-1a, 8-1b, and 8-1c show 1) the overall action area, 2) the extent of project-related noise, and 3) the extent of project-related aquatic effects.

1. The first step in defining the action area is to identify all potential project effects. In this example, there is construction and pile driving noise associated with roadway widening and culvert replacement activities. The aquatic effects include potentially increasing downstream turbidity, and providing 1,600 feet of upstream fish passage to a creek segment that was previously impassable.

2. The second step is to define the zone or area affected by each type of anticipated project-related effect. These zones and the rationale for establishing their limits are described in the text within Figures 8-1b and 8-1c.

3. The third step is determining the geographic extent of all project impacts. By combining or overlaying the zones of effect illustrated in Figures 8-1b and 8-1c, the project biologist can determine the geographic extent of all project effects (Figure 8-1a). Some projects may have multiple zones of effect that need to be considered simultaneously.

   Based on this combination of all relevant affected areas, the project biologist can then delimit the action area. The action area limits outline the outermost extent of contiguous project-related effects, plus any outlying areas that will sustain project-related effects (such as a wetland mitigation site).

The second example illustrates how an action area is defined for a project involving pile driving in a marine environment. Although other effects such as sedimentation or turbidity could also be generated by project activities, this example assumes that these zones of effect are confined within the area affected by project-related noise. Since the extent of project- related noise represents, geographically, the most far-reaching project effect, the limit of noise impacts is also considered the limit of the action area.

This example also illustrates the different attenuation rates of noise above and below water, demonstrating that noise impacts must be considered in a three-dimensional fashion. Figures 8-2a and 8-2b illustrate the aerial and underwater extent of the action area defined for this project, respectively.

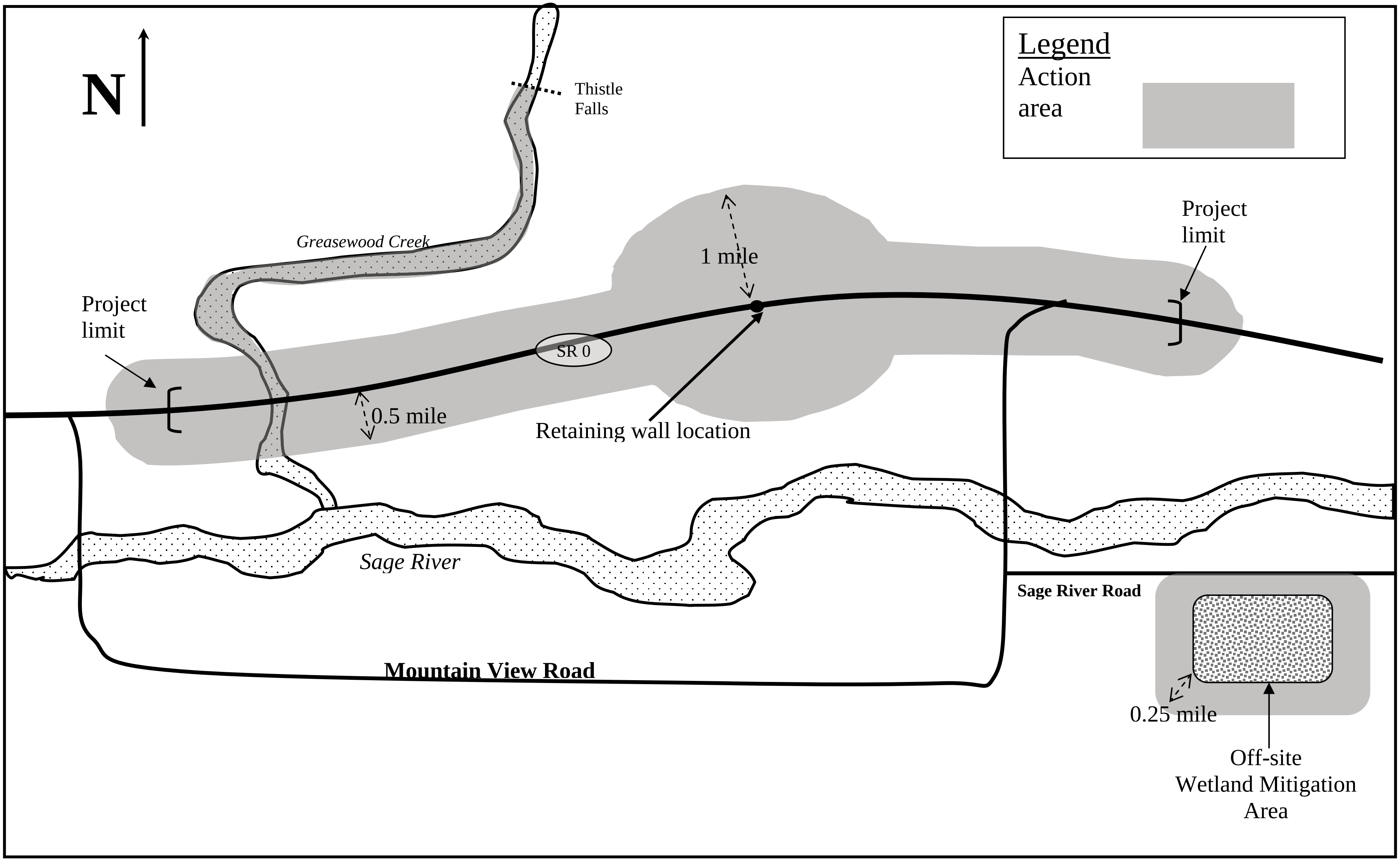


Figure 8-1a. Example showing project vicinity and action area limits.

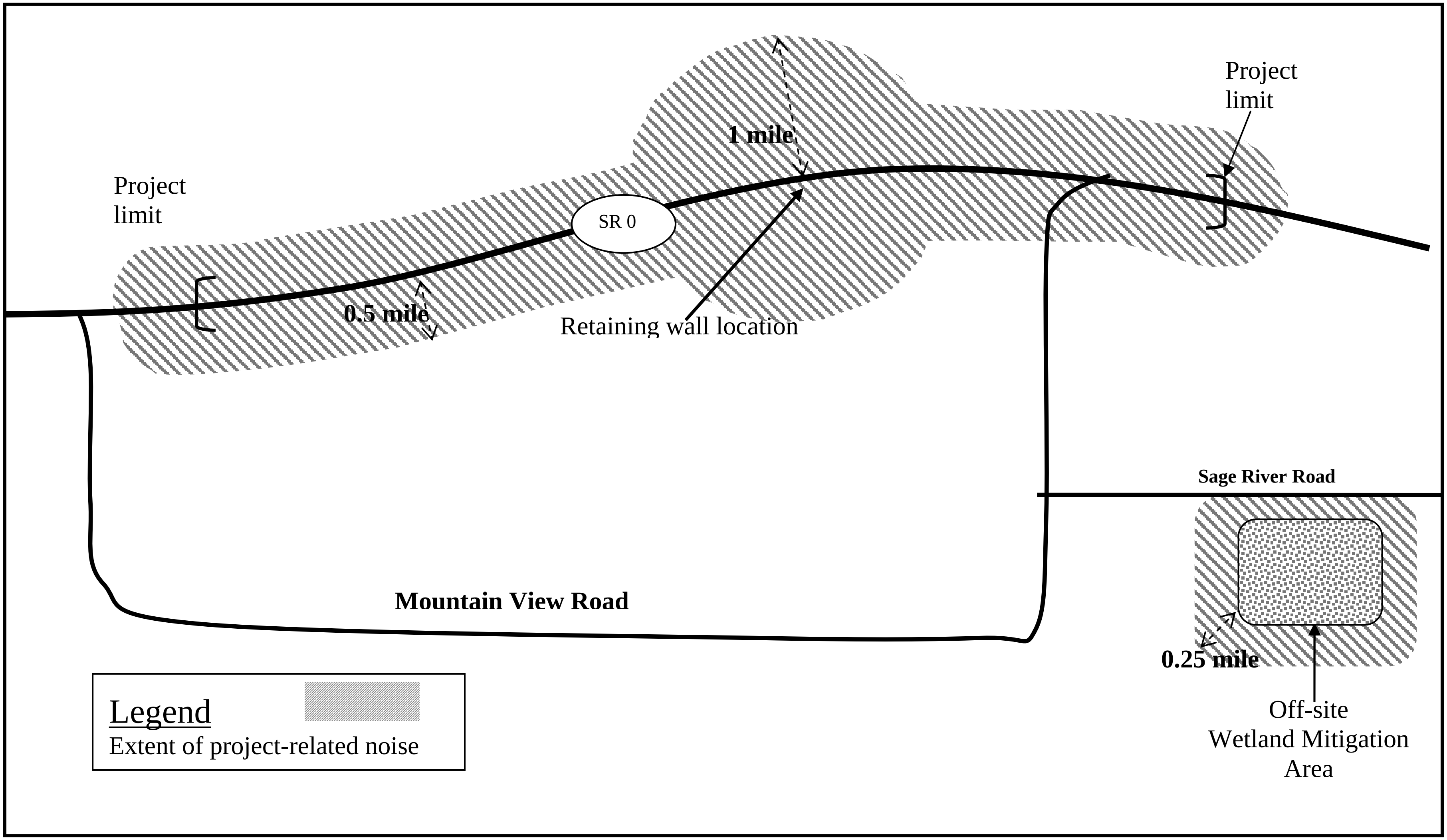


Figure 8-1b. Example showing extent of project-related noise.

The project consists of roadway widening, retaining wall construction, and a culvert replacement. The project limits shown above are the beginning and end points for the widening corridor. Noise associated with roadway widening is expected to extend 0.5 miles from the roadway. Construction of the retaining wall requires impact pile driving, and the extent of construction noise expands to 1 mile around this activity. The culvert replacement requires closure of SR 0 so traffic will be routed to Mountain View Road. A wetland mitigation site will be constructed near Sage River Road. Due to construction equipment noise at the mitigation site, project-related noise extends 0.25-mile around the wetland mitigation site.

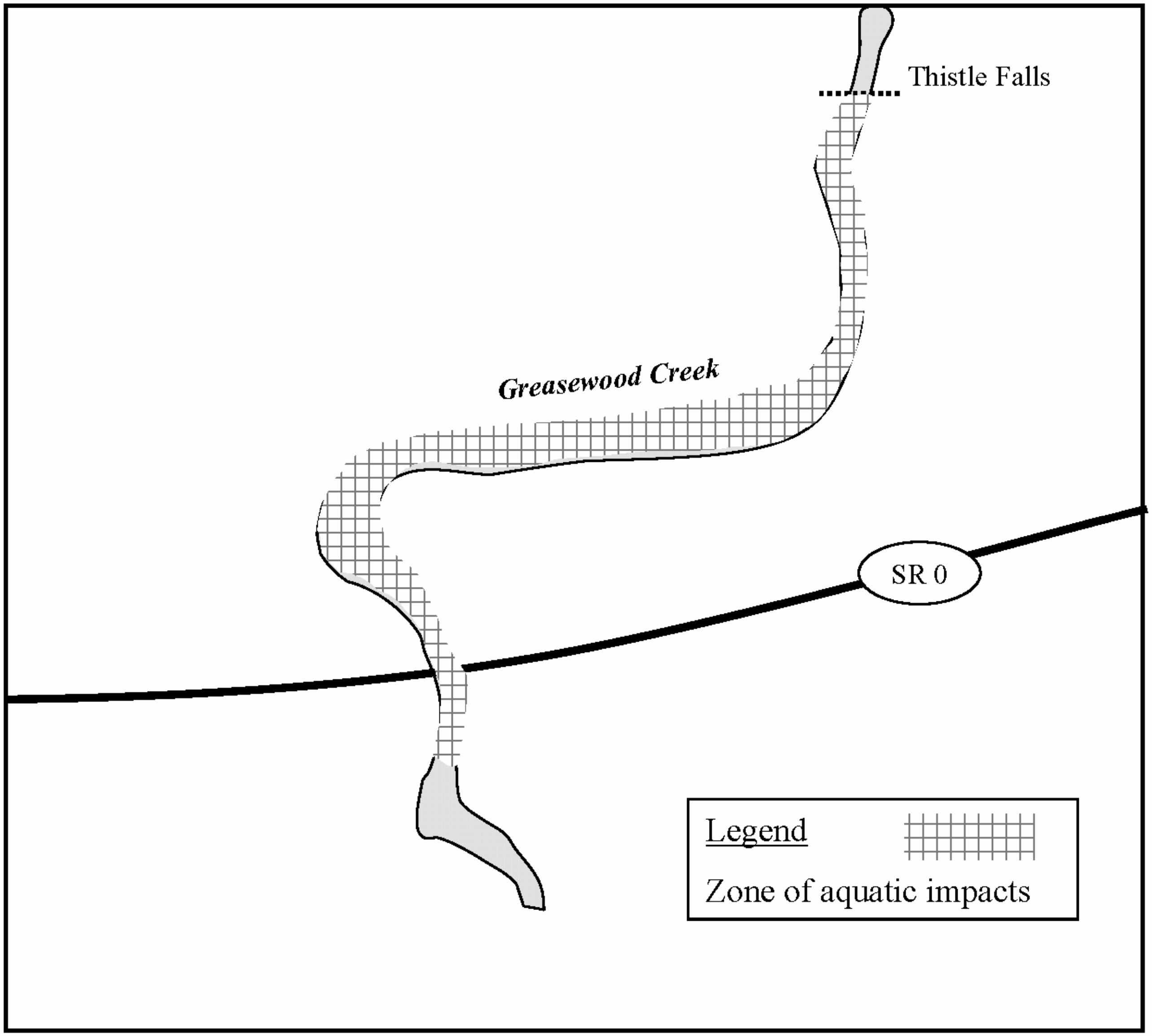


Figure 8-1c. Example showing extent of project-related aquatic effects.

The project will conduct in-water work by replacing a failed culvert on SR 0 over Greasewood Creek. The culvert has not allowed fish passage for several years, but after project completion, fish can access upstream habitat to Thistle Falls, which is an impassable natural barrier. This access to habitat is a beneficial effect, and therefore constitutes a project-related aquatic effect.

Aquatic effects extend from 300 feet downstream of the project area (Department of Ecology mixing zone criteria) to approximately 3 miles upstream (Thistle Falls).

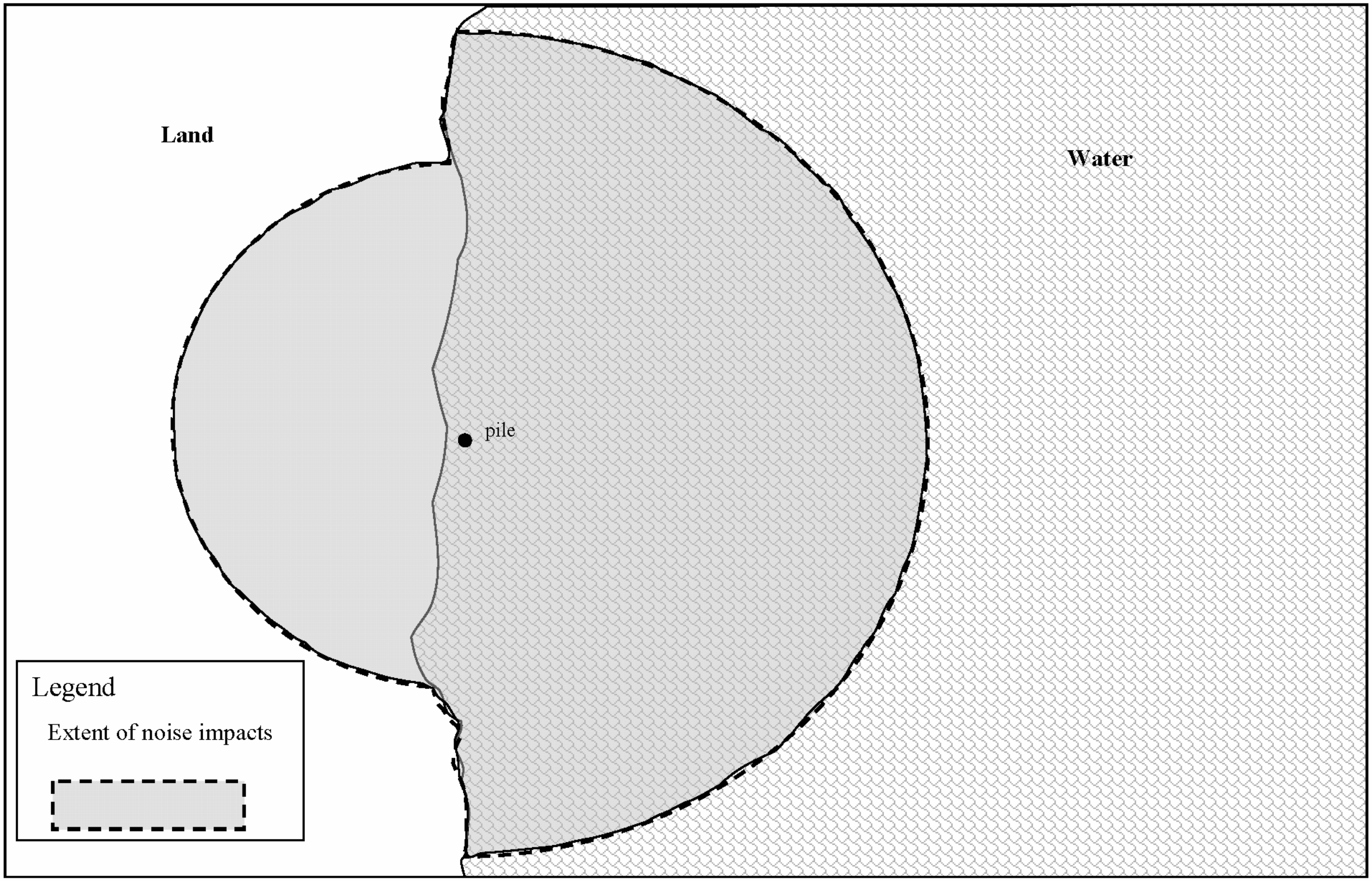


Figure 8-2a. Extent of project-related noise from pile driving in the near-shore marine environment (plan view).

This example shows the approximate extent of project-related noise (over land and water) resulting from marine pile driving activities. Noise attenuates at different rates over land (soft site) and over water (hard site), which explains the difference in radii. The limit of project-related noise is the distance at which noise from construction is indistinguishable from baseline noise.

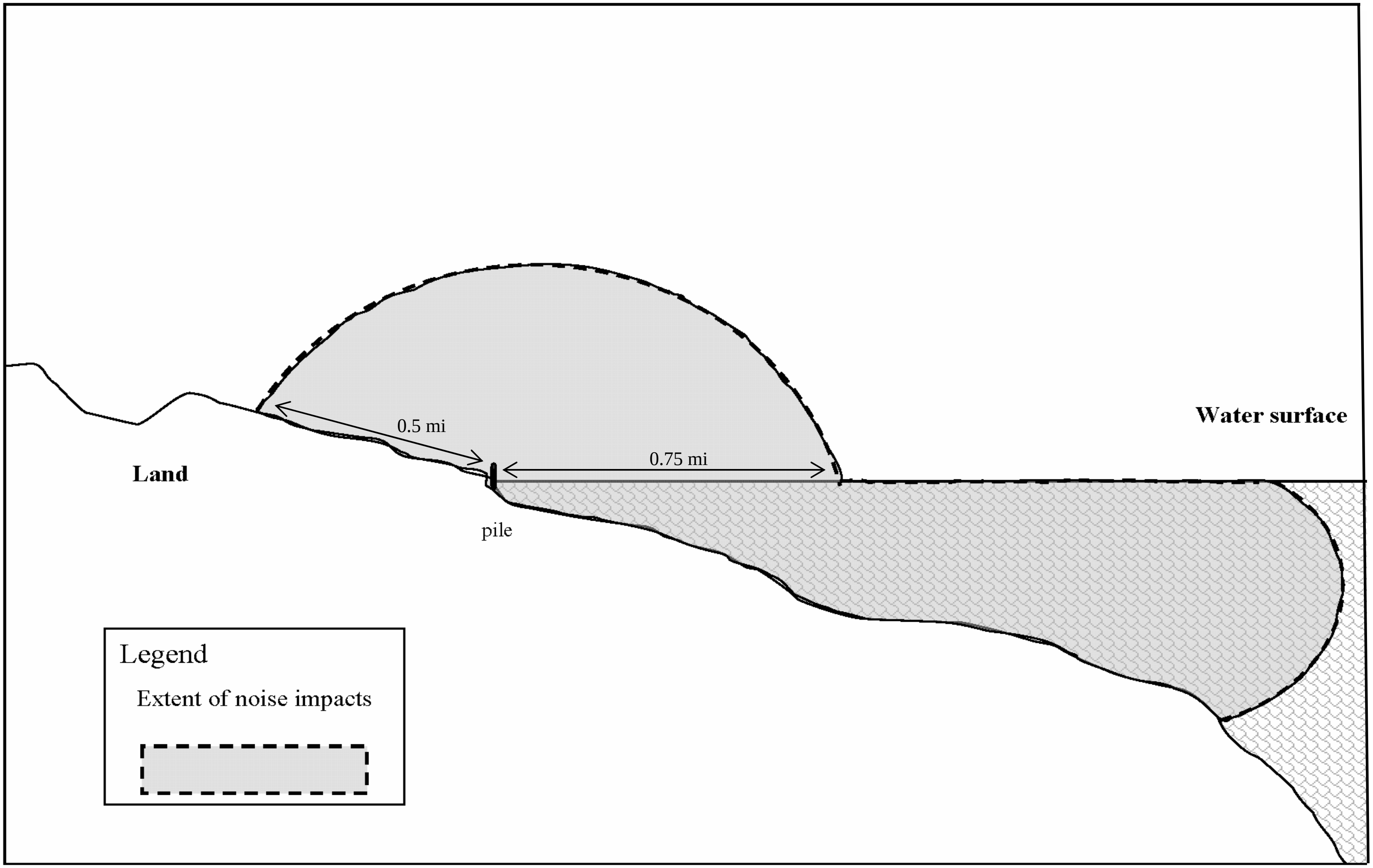


Figure 8-2b. Extent of project-related noise from pile driving in the near-shore marine environment (cross-sectional view).

This example displays the 3-dimensional aspect of noise extent. Note the difference in radius between over-land and over-water spreading.

8.1.2 Sample Biological Assessment Sections

Six examples of appropriately defined action areas are provided below.

The third example pertains to the construction of a highway interchange in the vicinity of freshwater resources. Project impacts include direct effects associated with clearing and grading and noise, as well as indirect effects associated with changes in traffic.

> The action area for this project on SR 0 (the creation of a new interchange) is defined based upon physical boundaries and logical limits of the area within which interchange traffic could reasonably be expected to originate.
>
> The western boundary of the action area is the slope located just west of Alder Road. There are no roads connecting Alder Road and Firville, so there is no possibility for vehicles west of Alder Road to use the interchange. The northern boundary of the action area is located halfway between the proposed interchange at Cottonwood Street and the existing interchange at Locust Street. This location (Oak Street) was chosen because vehicles north of this line will use the Locust Street interchange, and vehicles south of this line will use the Cottonwood Street interchange, the closest respective interchanges. While southbound vehicles north of Oak Street may use the Cottonwood Street interchange, and northbound vehicles south of Oak Street may use the Locust Street interchange, this traffic pattern is likely to be minimized by the new interchange.
>
> The eastern boundary of the action area corresponds to the Pine River for most of its length, because there is no access across the river, and no in-water work or aquatic impacts are associated with the project. The southern end of the action area includes the commercial/industrial-zoned area on the south side of the river, because there is access across the river on the existing bridge south of Maple City.
>
> Because construction noise impacts will not extend as far as the traffic impacts described above, noise impacts are not used to define the limits of the action area for this project (they are discussed in the effects analysis section, however). Similarly, the extent of vegetation removal associated with clearing and grading is confined to a smaller zone of effect within this larger action area.

The fourth excerpt explains the rationale underlying the definition of the action area for a project located within a marine system. This action area is based primarily on the limits of direct sediment effects associated with removal and replacement of an existing anchor system. Other impacts associated with the proposed action include noise from construction vessels and removal of the anchor system. Because of the surrounding bathymetry, the underwater extent of project-related to noise is confined to a much smaller area than the area affected by sedimentation. No noise impacts will affect habitats above water, because noise generated by construction vessels will not exceed noise levels generated by existing ferry and shipping traffic. Consequently, the limits of the action area for this project are based on the area affected by sedimentation.

> The action area for the proposed maintenance and replacement project is delineated on the north shore of Bay Harbor, extending 2,000 feet west and 2,000 feet east of the project site, and seaward to approximately –35 feet MLLW. This action area is based on the anticipated extent of sedimentation impacts affected by predominant currents and bathymetry in Bay Harbor. Incoming tides circulate west along the northern shore of the harbor and exit east along its centerline. Tidal currents near the project area tend to follow an east-west direction to approximately –35 feet MLLW. Beyond –35 feet MLLW, currents tend to form a gyre region (i.e., closed vortex system) during flood tides. Because of the existing circulation and bathymetry, sediment impacts associated with replacement of the floating dock anchor system will be confined within the geographic area described above.
>
> Extensive boat and tanker traffic operates within the harbor, where the bottom substrates consist of soft mud and silt. Consequently, noise impacts associated with removal and replacement of anchors will not likely exceed ambient conditions and will be confined within the action area defined above.

A fifth example defines a marine project's action area based upon the extent of anticipated noise. The project also has other effects, including turbidity from pile removal and installation, which will be confined to the immediate vicinity of the facility due to the lack of currents within the harbor and minimal tidal influence in the area. In addition, degradation of water quality and bottom sediments in the immediate vicinity is also likely to occur when new wooden piles are installed. But because project-related noise will extend farthest, the geographic limits of the area affected by project-related noise define the outer limits of the project action area. The example below explains the rationale for determining the extent of this action area. Note that the extent of the action area below and above water varies significantly. (For detailed information on how to complete noise analysis, see PART 2, NOISE IMPACT ASSESSMENT.)

> This section describes the action area for the Sandpiper Harbor Maintenance Facility. The action area is the defined geographic area potentially affected by the proposed project. For the purpose of establishing baseline conditions from which to evaluate potential effects of the project, the project activities, as well as physical site conditions such as substrate composition, were examined and evaluated.
>
> Project components that will generate impacts are pile removal and installation, which may result in increased sound pressure levels (during pile installation only); and water quality and turbidity impacts (during pile removal and installation) in the project area. The bottom substrates in Sandpiper Harbor consist of hard, dense silts.
>
> The area affected by turbidity or water quality degradation is confined to the immediate project vicinity due to the lack of currents within the harbor and minimal tidal influence in the area. The extent of project-related noise extends farther than the areas associated with other project effects and thus defines the limits of the underwater action area. The aquatic portion of the action area includes the area affected by underwater sound pressure from pile driving,

extending to where sound pressure levels intersect a land mass or attenuate to background levels.

Information from NOAA Fisheries suggests that impact pile installation of two 36-inch piles could generate sound pressure levels of 224 dB (Stadler 2003 personal communication). However, a bubble curtain capable of at least a 15 dB reduction will be used, lowering the anticipated peak sound pressure level to 209 dB_{PEAK}, and approximately 194_{RMS}. The remaining 45 piles will be 30 inches in diameter, so for the majority of the project, sound pressure levels will be considerably less than the noise levels assumed for the 36-inch piling.

It is assumed that noise will attenuate at a rate of 4.5 dB per doubling of distance, and will increase to 10 dB per doubling of distance beyond 0.6 miles (1 km), and will stop when it reaches the nearest land mass.

Based on these assumptions, peak sound pressure levels will decrease to ambient noise levels beyond 2,813 feet (0.53 miles). Sandpiper Harbor is only 0.35 miles across and 0.53 miles long, so it is assumed that the entire harbor area will be exposed to sound pressure levels over the 180 dB_{PEAK} ambient noise level. This area represents the area potentially affected by underwater noise during impact pile driving.

The terrestrial (above-water) portion of the action area, also based on anticipated noise impacts resulting from pile-driving activities, includes all upland areas within a one-mile radius of the project site.

A sixth example of how to define a project's action area, accompanied by an aerial photograph illustrating the extent of the action area (Figure 8-3), is provided below. The project entails rebuilding a bridge along SR 0. The action area encompasses the direct effects of the proposed action (noise and sedimentation/hydraulic impacts) as well as effects associated with the equipment access routes to be used for the project. In this example, the outer limits of the action area are determined by combining these multiple zones of effect.

The action area includes all areas that could be affected by the proposed project and is not limited to the actual work area. Noise and disturbance from construction activities have the potential to extend 500 feet outward from the project area. Project-induced sediment conveyance and hydraulic effects could affect Dogwood Creek and its stream banks up to 250 feet upstream of the bridge and 500 feet downstream of the bridge (Figure 8-3). Equipment access routes will generate impacts on both banks of Dogwood Creek, but these access routes are within the 500-foot action area.

Consequently, the action area has a radius of 500 feet in all directions from the project footprint, encompassing noise, equipment access, and sediment/hydraulic zones of effect. These distances are established with the confidence that they include all areas of conceivable impact associated with the proposed project.

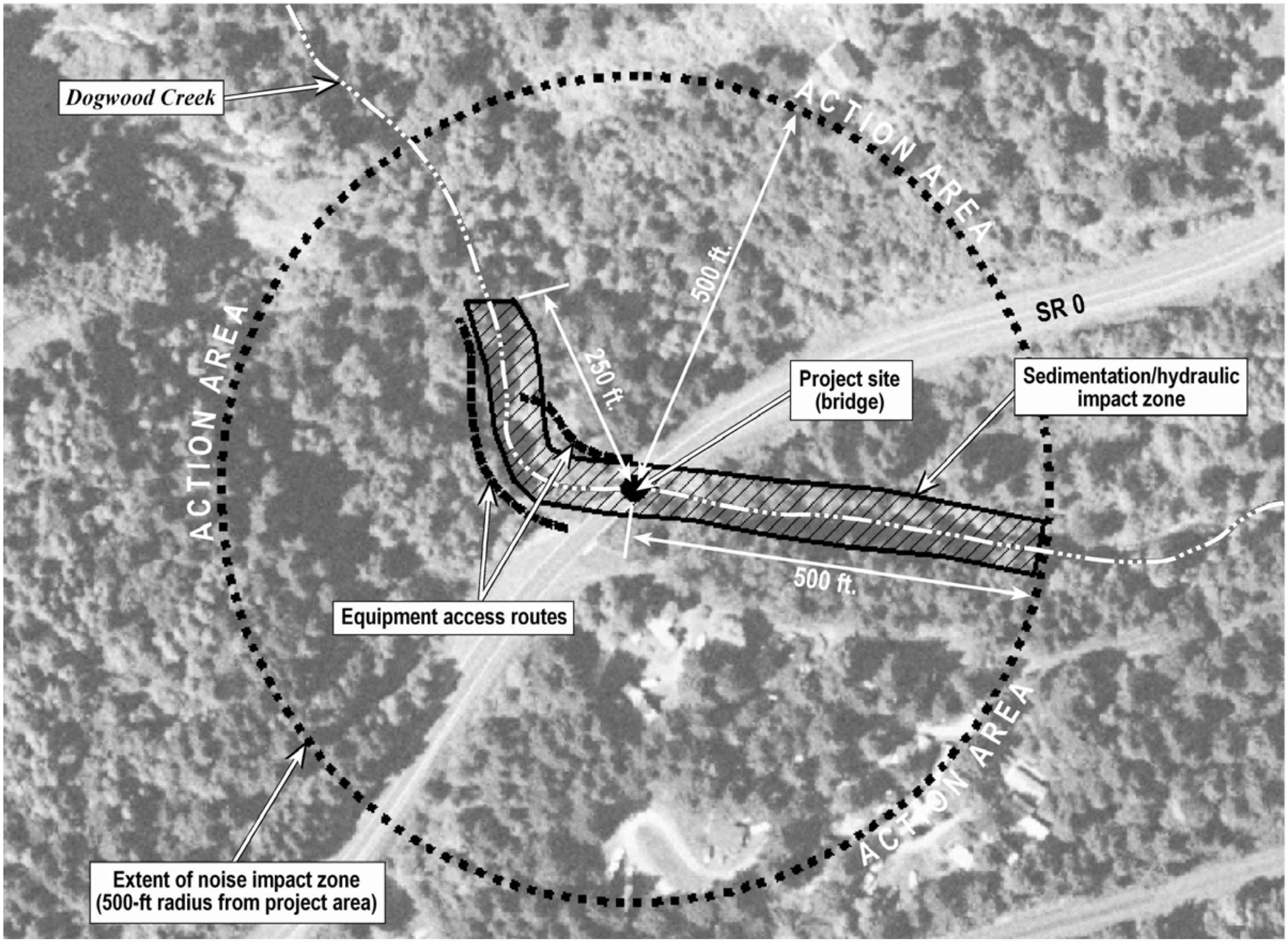


Figure 8-3. Detail of project action area including zone of effect for project-related noise sedimentation/hydraulic effects, and effects associated with the equipment access route.

9.0 Environmental Baseline within the Action Area

9.0 Environmental Baseline within the Action Area

Chapter Summary

- The BA should provide a brief description of general habitat and environmental conditions within the action area.
- For terrestrial and marine species, environmental conditions within the action area that are pertinent to the species' habitat requirements should be described.
- The environmental baseline discussion should describe habitat elements, significant to the species being addressed, that will be affected by the proposed action or that would affect the use of the action area by listed species.
- The environmental baseline analysis of freshwater systems can be completed at multiple scales.
- The NOAA Fisheries and USFWS matrices can be modified to accommodate site-specific environmental conditions.
- A single matrix can be used to address most of the pathways and indicators recognized by NOAA Fisheries and USFWS. If bull trout is addressed in the BA, the *subpopulation characteristics within the subpopulation watersheds* pathway and associated indicators should also be addressed.
- Summary tables of baseline conditions should be included within the text of the BA.
- Detailed environmental baseline discussions for each of the pathways and indicators addressed in the BA should be included in the BA appendices.
- At a minimum, the BA should assess the pathways and indicators that could be affected by the proposed action and that could result in effects on listed species or suitable and critical habitat.

This chapter discusses the types of information to be included in a BA pertaining to existing environmental conditions within the action area. The discussion of baseline environmental conditions is usually divided into two sections: 1) terrestrial and marine species, and 2) freshwater aquatic species. Accordingly, this chapter is divided into two corresponding sections.

9.1 Terrestrial and Marine Species: Environmental Baseline Information

This section provides guidance for documenting environmental conditions within the action area that are relevant for terrestrial and marine species that may be present.

The project biologist should describe existing environmental conditions and habitat features (with a focus on suitable habitat and critical habitat) within the action area. Some project biologists first describe these conditions in general, then provide more detail including findings from site visits. Other BA authors combine general and specific information regarding environmental conditions and species present.

One excellent resource for describing existing environmental conditions within watersheds is the Habitat Limiting Factors report series prepared by the Washington Conservation Commission, available by water resource inventory area (WRIA) at <http://salmon.scc.wa.gov/reports/index.html>.

For terrestrial and marine systems, existing environmental conditions that are pertinent to the species addressed in the BA should be described in detail, to provide reviewers with a clear sense of the features present and how they may be affected by the proposed action. Describe habitat characteristics that are suitable for various behavioral or life history requirements (e.g., foraging, nesting, denning, dispersal, and migration). These characteristics will vary depending upon the species addressed in the BA and their respective habitat requirements. In addition, the environmental setting discussion should describe habitat elements that will be affected by the proposed project activities.

9.1.1 Example BA Section

An example of a description of terrestrial habitat within the action area for a bridge repair project on the Olympic Peninsula appears below:

> Undisturbed land within the Soleduck watershed is dominated by Sitka spruce (*Picea sitchensis*) in the lowlands (Hook 2004). Early successional species and riparian species include hardwoods such as big-leaf maple (*Acer macrophyllum*) and red alder (*Alnus rubra*) (Hook 2004). Invasive plant species are becoming more established within the watershed; these include species such as Japanese knotweed (*Polygonum cuspidatum*) and reed canarygrass (*Phalaris arundinaceae*) (Hook 2004).
>
> Based on observations of Washington Department of Natural Resources (WDNR) orthophotographs and Landsat imagery documented in 2000, the action area is relatively flat, containing approximately 40 percent coniferous forest managed by WDNR and Washington State Parks. Much of this WDNR land within the action area appears to have been cut within the last 5 years, leaving the habitat as patchy second-growth mixed forest. These remaining narrow

patches range from 800 to 1,500 feet wide. This habitat is highly fragmented by clear-cuts, development, and logging roads, and is not likely to support species that depend on older, more complex habitats, like northern spotted owl and marbled murrelet. The project corridor runs east-west through the center of the action area. Old-growth forest is present over 2 miles north and south of the project site, well outside the action area. The rest of the land within the action area appears to be privately owned and includes a small campground, recently harvested timberlands, and other agricultural lands. Noise within the action area is low and is primarily influenced by traffic on the highway that bisects the action area.

An example of a description of the existing environmental conditions within the action area for a project in a marine system is provided below. This description combines general and specific information.

Bay Harbor is a protected bay on the east side of Cedar Island, Washington. The harbor is approximately 1 mile long and 1 mile wide. Three year-round streams and six seasonal streams drain in to Bay Harbor. Land use in Bay Harbor is predominantly residential, with some industrial and commercial development.

The action area for the Cedar Island ferry terminal project is on the north shore of Bay Harbor, extending 2,000 feet east and 2,000 feet west of the terminal, and seaward to approximately –30 feet mean lower low water (MLLW). A housing development and a ferry maintenance facility are located west of the terminal, and a parking area and residences lie to the east.

Habitat Conditions in Action Area

Substrate and slope—The shoreline in the action area is generally undeveloped. Some riprap exists east of the terminal. Substrate in the action area is gently sloping sand, gravel, and shell in the intertidal area, dropping off steeply toward the wing walls and dolphins. Wood and steel debris is common under the facility. The high tidal zones are characterized by cobble and gravel-sized sediment, and the mid- to low-intertidal areas are characterized by silt and sand.

Water quality, tides, and currents—Land uses in the action area include ferry operations and residential development. A marina, a ferry terminal maintenance facility, and other commercial development exist in Bay Harbor. A Superfund site is located in the harbor. Water quality has been designated degraded, but is improving as the Superfund site is cleaned up and as freshwater streams in the vicinity of the project are being restored to improve fish habitat.

Circulation in the action area is driven by tides and is somewhat influenced by vessel operations. The action area for the Cedar Island project, which encompasses the anticipated sedimentation impacts associated with the project, was selected based on the predominant currents and bathymetry in Bay Harbor. Incoming tides circulate west along the northern shore of Bay Harbor and exit along the centerline of the bay. Tidal currents near the terminal tend to follow an east-west direction to approximately –35 feet MLLW. Beyond –35 feet MLLW, currents tend to form a gyre region (i.e., closed vortex system) during flood tides.

Macrofauna and forage fishes—Surf smelt spawn year-round in Bay Harbor. WDFW Priority Habitats and Species maps show the presence of surf smelt spawning areas in the upper intertidal beaches adjacent to and under the Cedar Island ferry terminal.

Fish species commonly found in Bay Harbor include English sole, rock sole, C-O sole, shiner perch, and ratfish. Pacific herring have also been observed in the bay. The action area has documented year-round surf smelt habitat. Spawning occurs along the north shore of the harbor from the ferry maintenance facility east to Pine Point at the mouth of Bay Harbor.

In a dive survey conducted on *month/day/year*, few organisms were observed in the area beneath the dock. Species observed include red rock crab, horse clam, sea star, and anemone. Rock boring piddock (*Zirfaea pilsbryi*) bivalves were commonly found on timber and concrete piles.

Vegetation—The most common algal species under the facility include *Ulva* sp. and diatoms. While there are no eelgrass or kelp communities in the action area, both are present at the mouth of Bay Harbor near Pine Point, approximately 0.75 miles from the project area. The upper shoreline in the action area is relatively flat and is characterized by trees, shrubs, and some residential clearing and landscaping.

9.2 Freshwater Aquatic Species: Environmental Baseline Information

This section provides guidance for addressing and documenting aquatic environmental baseline conditions in relation to a project. Two examples are provided that give examples of how environmental baseline information might be incorporated into a BA using text and summary tables of baseline conditions. The two examples also illustrate how this information may be provided at three different scales: watershed, action area, or zone of effect. In addition, general information and resources for this analysis and the NOAA Fisheries and USFWS matrices and tables are provided.

Both NOAA Fisheries and USFWS have developed documents to outline frameworks for providing consistent and logical lines of reasoning to aid in determining when, where, and why listed species suffer adverse effects. The documents provide diagnostic matrices, environmental baseline checklists, and dichotomous keys for making determinations of effect and documenting expected incidental *take*. The matrices aid project biologists in diagnosing pathways of effects and indicators of those effects. The tables facilitate the documentation of the environmental baseline conditions and potential effects of the proposed action on relevant indicators for the aquatic environment.

These documents originally were developed to provide the information needed to evaluate effects of proposed and ongoing land management actions of the U.S. Forest Service and U.S. Bureau of Land Management related to the persistence and potential recovery of proposed and listed salmonids. As a result, the matrices are not well adapted for characterizing conditions in urban areas or specific locations within a watershed.

9.2.1 The Importance of Scale in Analysis of Environmental Baseline Conditions

In describing the environmental baseline conditions for projects potentially affecting aquatic species, a project biologist should assess whether baseline indicators and pathways are properly functioning, at risk, or are not properly functioning at the action area scale, the project setting scale, and/or the watershed scale. NOAA Fisheries has a preference for this information being evaluated at the watershed scale. However it can be useful to catalogue conditions and impacts at a smaller scale particularly if the area of aquatic impacts does not mirror the action area defined for the project.

The project biologist may begin by characterizing baseline conditions at a project footprint or zone of effect scale, an action area scale, or a watershed scale, and then subsequently analyze the impacts of the project at a different scale or by juxtaposing the project impacts at different scales within the watershed. This form of analysis provides greater contextual information for determining the small- and large-scale impacts of a project.

Some BAs begin with a detailed project setting or a watershed description immediately followed by a discussion of environmental baseline conditions pertaining to the action area. This approach allows the author to present a scaled view of the environmental conditions in the watershed versus the action area. Another possible approach would be to provide a scaled discussion of the action area versus the location of proposed work or a smaller zone of effect within the larger action area. In some projects, an author may choose to provide general information at the environmental setting or watershed level and detailed environmental baseline information only at the smallest scale.

For example, a project biologist may plan to discuss environmental baseline conditions and impacts on them at a large scale juxtaposed with a discussion of environmental baseline conditions at the action area scale, to include in the ENVIRONMENTAL BASELINE OF ACTION AREA section of the BA. Similarly, a project biologist may choose to evaluate environmental baseline conditions only at the action area scale juxtaposed with a description of conditions at the zone of effect scale.

The two examples that follow provide a general description of the baseline conditions and the tables with the pathway and indicator matrices in the body of the document. NOAA Fisheries no longer requires that all of the pathways and indicators in its matrix document be analyzed in every BA prepared for listed salmonid species under NOAA jurisdiction. However, at a minimum, the pathways and indicators that could be affected by a proposed action and that could result in effects on listed species and critical habitat should be assessed within the body of the

BA. Text to accompany the indicators that will not be affected by a proposed action can be placed in an appendix of the BA. In addition to looking at these general environmental parameters, projects with stormwater impacts will need to do a detailed description of the baseline water quality conditions. Refer to CHAPTER 17- STORMWATER BMP IMPACT ASSESSMENT for more information.

9.3 Examples of Three Scales of Analysis

The following two examples illustrate how three different scales may be used to describe environmental baseline conditions in relation to a proposed project.

The first example effectively scaled overview of both watershed (project setting) and action area environmental baseline conditions and impacts.

Two Scales Juxtaposed: Watershed and Action Area Environmental Baseline Information

> ***Setting***. Red Creek Bridge is located on SR 0 at MP 0.00 within Section ##, Township ## North, Range ## East). The bridge is sited on relatively steep sloping terrain descending southward in elevation to the Yellow River. Land uses within the project vicinity include tourism, recreation, forestry, and rural residential. A state park, a national wildlife refuge, a national forest, private residences, and private timber companies represent the primary land managers/owners within this forested landscape. The project lies within the boundaries of a national scenic area, which stretches nearly 83 miles from Violet Creek in Clark County to about 4 miles east of Bluetown in Klickitat County. The Red Creek Bridge vicinity is classified by Cowlitz County as a special management area under the county's Yellow River National Scenic Area ordinance.
>
> The project is located within the southern Washington Cascades physiographic province, which extends south from Snoqualmie Pass to the Columbia River and is dominated by the volcanic trio of Mt. Rainier, Mt. Adams, and Mt. St. Helens. The province is characterized by relatively mountainous terrain separated by steep, deeply dissected valleys.
>
> The project is specifically sited in the Red River water resource inventory area (WRIA) #00. WRIA 00 encompasses the southwestern half of Clark County and the southwest corner of Cowlitz County, an approximate area of 494 square miles. Topography in the west portion of WRIA 00 consists of broad alluvial flats separated by groups of low hills; thus stream gradients tend to be gentle. Eastward into Cowlitz County, more precipitous topography creates moderate to high-gradient streams.
>
> Soils in the project area are identified as Bonneville stony sandy loam, a very deep, somewhat excessively drained soil derived from alluvium. Fairly widespread surface water degradation has occurred in this WRIA, particularly in Clark County, attributed to nonpoint pollution sources such as agriculture,

inadequately controlled land clearing, and contaminated runoff. It is estimated that only about 5 percent of the original salmon and steelhead populations have survived in WRIA 00 (Washington Department of Ecology 1998).

Red Creek comprises an independent drainage within WRIA 00 approximately 7,000 acres in area. Its confluence with the Yellow River occurs at RM 141. Streamflow is derived chiefly by rain-produced surface and ground water runoff. There are approximately 4.5 miles of Red Creek main stem, with headwaters originating at an elevation of 3,000 feet. Red Creek has two unnamed tributaries, both of which originate at 3,000 feet. One comprises about 2.3 miles and flows into the Red Creek main stem at approximate RM 4.5. The second tributary is about 6 miles in length and meets the main stem at roughly RM 2.3. The steep gradient of Red Creek is identified as a physical barrier to coho salmon use above RM 2.0 (Washington Department of Fisheries [WDF] 1973).

The Red Creek watershed is densely forested with second and third growth timber, suggesting sustained timber extraction over the last century. While timber harvest likely continues, particularly on privately-held forest lands in the mid- and upper watershed, forest practices must comply with regulations administered under the Yellow River National Scenic Area ordinance to protect scenic, cultural, natural, and recreation values. The watershed has been lightly affected by human habitation, typified by rural residences and small mobile home parks concentrated along the SR 00 corridor. The two primary zoning overlays are public recreation (associated with an adjacent state park) and forestry.

Under the Cowlitz County Yellow River National Scenic Area ordinance, buffers are delineated for all regulated activities adjacent to streams. As a fish-bearing perennial stream zoned as a special management area, the ordinance designates a stream buffer width of 200 feet for Red Creek (Cowlitz County 1994). Red Creek is also designated a conservancy area under the county shoreline master program. Conservancy areas are designated to protect, conserve, and manage existing natural resources and valuable historic and cultural areas in order to ensure a continuous flow of recreational benefits to the public and to achieve sustained resource utilization.

Vegetation in the project vicinity is typical of plant assemblages found in the west end of the Yellow River valley. Douglas fir (*Pseudotsuga menziesii*) comprises the dominant overstory tree over much of the landscape, with lesser occurrence by big-leaf maple (*Acer macrophyllum*) and red alder (*Alnus rubra*). Understory vegetation consists of vine maple (*Acer circinatum*), salal (*Gaultheria shallon*), orange honeysuckle (*Lonicera ciliosa*), and bracken (*Pteridium aquilinum*). Red alder is the dominant tree in the Red Creek riparian zone, with some willow (*Salix* sp.) and big-leaf maple interspersed.

The Red Creek channel in the vicinity of the bridge appears to have been significantly altered in the past. An abandoned roadbed of unknown construction date is evident along the west bank of Red Creek immediately north of the bridge (a portion of this roadway has sloughed away with the embankment failure). It was likely built to access two quarry sites located up-drainage from the bridge. The roadbed appears to function as a dike that confines the Red Creek channel.

The natural topography of the area suggests that (pre-roadbed) the channel was substantially wider with some flow meandering southwest of the current channel.

An old channel of Red Creek is still apparent on Washington State Parks and Recreation Commission (WSPRC) property south of SR 00 and west of an existing mobile home park. There are anecdotal reports that the Red Creek channel was diverted around the turn of the century so as to minimize the number of crossings required by a new rail line (*reference*). WDFW and WSPRC staff theorize that these historical modifications to the Red Creek channel have contributed to the existing embankment failure at the bridge (*reference*).

Environmental Baseline. An evaluation of the baseline environmental conditions for the project action area was conducted for chinook, chum, coho, and steelhead following *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale* (NOAA Fisheries 1996). This evaluation assessed several baseline indicators and determined whether the proposed project would restore, maintain, or degrade existing baseline conditions at the watershed and project area level (Table 9-1). The results of this evaluation are summarized in Table 9-2. A literature search of published information on the condition and/or limiting factors of the Red Creek watershed yielded little information (a limiting factors report for WRIA 00 is currently underway by the Washington Conservation Commission). The evaluation that follows is based on review of aerial photos, field observation, best professional judgment, and consultation with WDFW staff. Figure 9-1 illustrates the characteristics of Red Creek south and north of the bridge.

Table 9-1. Table excerpt illustrating environmental baseline conditions at the watershed and action area scales.

Pathways: Indicators	Red Creek Watershed Baseline	Project Effect(s) on: Watershed Baseline	Project Effect(s) on: Action Area Baseline
Temperature	The lower reach of Red Creek is naturally prone to low summer flows (WDF 1975) due to its steep gradient and relatively low-elevation headwaters, hence, may be prone to elevated summer temperatures that may impair salmonid production. However, riparian vegetation is well established across the watershed. Both deciduous and conifer tree species function to shade and cool water temperatures during summer low flow periods. Baseline conditions for temperature, therefore, are determined to be ***properly functioning*****.**	The proposed action will have minor impacts on riparian reserves, though likely not measurable at the watershed scale. Project effects are expected to ***maintain*** the watershed temperature baseline.	Similarly, the proposed action will sparingly remove select trees for equipment access. Loss of up to seven trees will be offset by post-construction plantings. No measurable change to stream temperature is expected, therefore, the project will ***maintain*** the temperature baseline within the project area.
Sediment/ Turbidity	Spring runoff and storm events are considered the primary sediment input sources in the Red Creek system. Anthropogenic causes of sedimentation (logging, road building) have not occurred at levels or densities to result in watershed degradation. A recent earthquake (a rare local event) contributed to mass soil movement into Red Creek just upstream from the action area (*reference*). Background levels of sediments appear to be within the normal range for a stream with flashy characteristics. The water quality pathway indicator for sediment is determined to be ***properly functioning***.	Bank stabilization and restoration measures are expected to ***maintain*** the environmental baseline for sediment/turbidity over the long term.	Stream barb construction activities will likely result in minor, temporary increases in sedimentation and turbidity levels, which will ***temporarily degrade*** the environmental baseline at the project scale. However, bank restoration work is expected to ***maintain*** the project area baseline through long term stabilization of the scoured bank.
. . . (*table continues*)			

Table 9-2. Summary of environmental baseline conditions discussing previous table by watershed and project area scales.

Pathways:	Environmental Baseline			Project Effects at Watershed Scale			Project Effects at Project Scale		
Indicators	Properly Functioning	At Risk	Not Properly Function	Restore	Maintain	Degrade	Restore	Maintain	Degrade
Water Quality:									
Temperature	X				X			X	
Sediment	X				X			Long term X	Short-term X
Chem. contam./nutrients	X				X			X	
Habitat Access:									
Physical barriers	X				X			X	
Habitat Elements:									
Substrate	X				X				Slightly X
Large woody debris	X				X			X	
Pool frequency	X				X			X	
Pool quality	X				X			X	
Off-channel habitat	X				X			X	
Refugia	X				X			X	
Channel Cond. & Dynamics:									
Width/depth ratio	X				X				Slightly X
Stream bank condition	X				X			X	
Floodplain connectivity	X				X			X	
Flow/Hydrology:									
Change in peak/base flows	X				X			X	
Drainage network increase	X				X			X	
Watershed Conditions:									
Road density & location	X				X			X	
Disturbance history	X				X			X	
Riparian reserves	X				X			X	

View looking south

View looking north

Figure 9-1. Views of Red Creek looking south and north from Red Creek bridge.

The above environmental baseline discussion and matrix were included in the BA submitted to both NOAA Fisheries and USFWS for this project. The additional USFWS indicators were also addressed within the text of the document.

In the example provided below, the action area of the project was determined by the distance noise impacts would extend from the project area. This action area was predominantly on land, and within it there was a much smaller zone of potential aquatic effects. No terrestrial listed species were present in the vicinity of the project, but listed fish were present. As a result, the project biologist focused the detailed environmental baseline discussion on this smaller zone of project-related aquatic effects and provided more general environmental information for the watershed as a whole.

Extent of Project-RelatedAquatic Effects (within Project Action Area and Watershed Level) Environmental Baseline Information

Environmental Baseline in Action Area: Adams Creek

Adams Creek, which is 10.00 miles in length, historically originated from a series of springs and seeps near Bakerville. Adams Creek flows as a low-gradient stream with limited spawning substrate in the lower 8 miles. Limited suitable spawning habitat is found in the fluvial run-out area of Helens Creek, located at Adams Creek RM 9.15, several miles upstream of the project area. As a result (and also due to the fact that Adams Creek in the immediate vicinity of I-5 and the project area is somewhat tidally influenced), the portion of the Adams Creek system in the project area functions primarily as a conduit for migrating salmonids (Jones 2001). Currently chum and coho are known to use the system; there has been reported but not confirmed use of Adams Creek by chinook.

Limiting factors for salmonid production in this system are occasional low summer flows and warm water temperatures, degraded water quality in the lower estuary areas, and heavy streambed siltation resulting from development activities in surrounding areas (WCC 1999). A summary of environmental baseline conditions for Adams Creek is provided in Table 9-3.

Disturbance History, Watershed Condition – The creek meanders through historical agricultural lands that have been transformed into residential, urban, commercial warehouse, and light industrial uses. Between I-5 and Bachelor Bay, the creek courses through a heavily industrialized area. Adams Creek as a whole does not have functioning riparian habitat for salmonids, as the historical coniferous riparian buffer has been replaced by reed canarygrass, limited small woody vegetation, and development.

Land use in the vicinity of the project area is a mixture of urban commercial and suburban residential. There are still a few remaining open areas throughout the project area, such as undeveloped floodplain and farms. Three of the four quadrants at the Adams Creek crossing have commercial development, while one remains residential.

Table 9-3. Summary of environmental baseline conditions of Adams Creek in the project action area.

Pathways	Indicators	Environmental Baseline: Properly Functioning	Environmental Baseline: At Risk	Environmental Baseline: Not Properly Functioning
Water Quality:				
	Temperature	X - site visit	X - seasonally	
	Sediment		X - mostly silt and fines	
	Chem. contam. & nutrients		X	
Habitat Elements:				
	Barriers	X - action area	*X - upstream of project area, stormwater bypass system*	
	Substrate		X	
	Large woody debris			x
	Pool frequency			X - in lower portions of creek
	Pool quality			X
	Large pools			X
	Off-channel habitat			X
	Refugia		X	
Channel Cond. & Dyn.:				
	Stream bank condition			X
	Floodplain connectivity			X
Flow/ Hydrology				
	Peak/base flows			X
Watershed Conditions:				
	Riparian reserves			X

Water Quality – Water quality is a limiting factor throughout the system downstream of Adams Creek. Adams Creek was listed on the approved 1996 Ecology 303(d) list for dissolved oxygen and fecal coliform bacteria. Because of the total lack of large riparian vegetation and overallocated streamflows (discussed below), it is surprising that the creek has not been 303(d) listed for high temperatures (WCC 1999). Temperature during a site visit on 2-28-01 was 6°C (42.8°F). Temperatures throughout this system are high and water quality is poor during the summer months (*reference*).

Habitat Elements – Substrates in the vicinity of the I-5 corridor consisted of a silt sandy bottom with minimal gravels (<10%). The channel was on average 30–40 centimeters (cm) (12–18 inches) in depth. The wetted channel was 1.5–3.5

meters (5–11.5 feet) in width under bridge A. Riffle and glide habitat types were present under this bridge. Under bridge B, the channel was 30–40 centimeters (12–18 inches) in depth, and ranged from 2.5 to 4 meters (8 to 13 feet) in width, and consisted of riffle-glide habitat types. As summarized from the Limiting Factors Analysis report for WRIA 10 (WCC 1999), Adams Creek does not have a functioning riparian habitat for salmonids. A historical riparian buffer has been replaced by reed canarygrass and manicured lawn (WCC 2000). As a result, only small woody vegetation exists throughout the creek channel. In its lower reaches the creek is heavily channelized (WCC 1999). This was confirmed by a site visit on 2-28-01. It was observed that no large woody debris was present in the project area, nor is it likely to occur in the lower portion of the basin due to current land uses and disturbance history in the basin.

Riparian vegetation in the median area between the bridges and to the outer extent of the right-of-way consisted of reed canarygrass, scattered stems of Douglas spirea, Himalayan blackberry, creeping blackberry, and red alder. Red alder trees 10 to 25 cm in diameter at breast height (4 to 10 inches dbh) were present immediately north of the project area near the A-Town car dealership and will not be affected by the proposed activities.

Flow/Hydrology – The creek has had critically low flows for the last 20 years, resulting from water withdrawals for agricultural activities and also a water diversion structure at river mile 11.7. This structure, a diversion pipe, was installed to channel flows from upper Adams into a stormwater bypass system that flows into the Rainier River. The project was intended to prevent flooding in Adams Creek by diverting peak flows into the bypass system. However, under normal flows the project diverts all upper Adams flows into the bypass and directs only flood flows into lower Adams Creek (WCC 1999).

9.4 Information and Resources

There are several sources of information pertaining to assessments of environmental baseline conditions:

- *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale* (NOAA Fisheries 1996).
- *A Framework to Assist in Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Bull Trout Subpopulation Watershed Scale* (USFWS 1998).
- Washington Conservation Commission 1999–2000 Limiting Factors Analysis reports for Washington state WRIAs. Reports can be ordered online at <http://salmon.scc.wa.gov/contact/request.html>.

- Clean Water Act section 303(d) lists provided by the Department of Ecology for threatened waters in the state of Washington, available online at <http://www.ecy.wa.gov/programs/wq/303d/index.html>.
- *A Catalog of Washington Streams and Salmon Utilization*, Volumes 1 (Puget Sound) and 2 (Coastal). Washington Department of Fisheries. November 1975.
- 1998 Washington State Salmon and Steelhead Stock Inventory (SASSI) – Bull trout appendix. Washington Department of Fish and Wildlife and Western Washington Treaty Tribes. Available at <http://wdfw.wa.gov/fish/sassi/bulldolly.pdf>.
- 2000 Washington State Salmon and Steelhead Stock Inventory (SASSI) – Coastal cutthroat trout appendix. Washington Department of Fish and Wildlife and Western Washington Treaty Tribes. Available at <http://wdfw.wa.gov/fish/sassi/cutthroat.pdf>.
- 1992 Washington State Salmon and Steelhead Stock Inventory (SASSI) – Appendices 1, 2, and 3. Washington Department of Fish and Wildlife and Western Washington Treaty Tribes. Available at <http://wdfw.wa.gov/fish/sassi/sassi92.pdf>.
- 2002 Salmonid Stock Inventory, interactive website: <http://wdfw.wa.gov/fish/sasi/>.
- Local municipality or county sensitive areas databases and reports, basin plans, watershed reports, and project BAs contain valuable site-specific information. Project biologists should contact the nearest county or municipality environmental or planning office to determine the availability of these resources.

In addition to these selections, other references are provided on the compact disc accompanying this manual.

9.5 NOAA Fisheries and USFWS Matrices

The Services have developed matrices and tables for assessing and documenting environmental baseline conditions in the action area of proposed projects potentially affecting freshwater riparian habitats. These tools are provided in Tables 9-4 through 9-7.

Table 9-4. NOAA Fisheries matrix of pathways and indicators.

Pathway	Indicators [a]	Properly Functioning	At Risk	Not Properly Functioning
Water Quality	Temperature	50–57ºF [b]	57-60º (spawning) 57-64º (migration &rearing) [c]	> 60º (spawning) > 64º (migration & rearing) [c]
	Sediment/turbidity	<12% fines (<0.85 mm) in gravel [d], turbidity low	12-17% (west-side) [d], 12-20% (east-side) [c], turbidity moderate	>17% (west-side) [d], >20% (east side) [c] fines at surface or depth in spawning habitat [c], turbidity high
	Chemical contamination and nutrients	Low levels of chemical contamination from agricultural, industrial and other sources, no excess nutrients, no Clean Water Act 303(d) designated reaches	Moderate levels of chemical contamination from agricultural, industrial and other sources, some excess nutrients, one Clean Water Act 303(d) designated reach [f]	High levels of chemical contamination from agricultural, industrial and other sources, high levels of excess nutrients, more than one Clean Water Act 303(d) designated reach [f]
Habitat Access	Physical barriers	Any manmade barriers present in watershed allow upstream and downstream fish passage at all flows	Any manmade barriers present in watershed do not allow upstream and/or downstream fish passage at base/low flows	Any manmade barriers present in watershed do not allow upstream and/or downstream fish passage at a range of flows
Habitat Elements	Substrate	Dominant substrate is gravel or cobble (interstitial spaces clear), or embeddedness <20% [d]	Gravel and cobble is subdominant, or if dominant, embeddedness 20-30% [d]	Bedrock, sand, silt or small gravel dominant, or if gravel and cobble dominant, embeddedness >30%[c]
	Large woody debris	<u>Coast:</u> >80 pieces/mile >24-inch diameter, >50 ft. length;[e] <u>East side:</u> >20 pieces/ mile >12-inch diameter, >35 ft. length;[c] and adequate sources of woody debris recruitment in riparian areas	Currently meets standards for properly functioning, but lacks potential sources from riparian areas of woody debris recruitment to maintain that standard	Does not meet standards for properly functioning and lacks potential large woody debris recruitment
	Pool frequency <u>channel width</u> <u># pools/mile</u> [g] 5 feet 184 10 inches 96 15 inches 70 20 inches 56 25 inches 47 75 inches 23 100 inches 18	Meets pool frequency standards (left) and large woody debris recruitment standards for properly functioning habitat (above)	Meets pool frequency standards but large woody debris recruitment inadequate to maintain pools over time	Does not meet pool frequency standards

Table 9-4. NOAA Fisheries matrix of pathways and indicators (continued)**.**

Pathway	Indicators [a]	Properly Functioning	At Risk	Not Properly Functioning
Habitat Elements (continued)	Pool quality	Pools >1 meter deep (holding pools) with good cover and cool water [d], minor reduction of pool volume by fine sediment	Few deeper pools (>1 meter) present or inadequate cover/temperature [d], moderate reduction of pool volume by fine sediment	No deep pools (>1 meter) and inadequate cover/temperature [d], major reduction of pool volume by fine sediment
	Off-channel habitat	Backwaters with cover, and low energy off-channel areas (ponds, oxbows, etc.) [d]	Some backwaters and high energy side channels [d]	Few or no backwaters, no off-channel ponds [d]
	Refugia (important remnant habitat for sensitive aquatic species)	Habitat refugia exist and are adequately buffered (e.g., by intact riparian reserves); existing refugia are sufficient in size, number and connectivity to maintain viable populations or sub-populations [h]	Habitat refugia exist but are not adequately buffered (e.g., by intact riparian reserves); existing refugia are insufficient in size, number and connectivity to maintain viable populations or sub-populations [h]	Adequate habitat refugia do not exist [h]
Channel Condition & Dynamics:	Width/depth ratio	<10[c,e]	10–12 [n]	>12 [n]
	Stream bank condition	>90% stable; i.e., on average, less than 10% of banks are actively eroding [c]	80–90% stable	<80% stable
	Floodplain connectivity	Off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession	Reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession	Severe reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas; wetland extent drastically reduced and riparian vegetation/succession altered significantly
Flow/Hydrology:	Change in peak/base flows	Watershed hydrograph indicates peak flow, base flow and flow timing characteristics comparable to an undisturbed watershed of similar size, geology and geography	Some evidence of altered peak flow, base flow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography	Pronounced changes in peak flow, base flow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography
	Increase in drainage network	Zero or minimum increases in drainage network density due to roads [i,j]	Moderate increases in drainage network density due to roads (e.g., 5%) [i,j]	Significant increases in drainage network density due to roads (e.g., 20-25%) [i,j]
Watershed Conditions:	Road density & location	<2 mi/mi² [l], no valley bottom roads	2–3 mi/mi², some valley bottom roads	>3 mi/mi², many valley bottom roads

Table 9-4. NOAA Fisheries matrix of pathways and indicators (continued)**.**

Pathway	Indicators [a]	Properly Functioning	At Risk	Not Properly Functioning
Watershed Conditions (continued):	Disturbance history	<15% ECA (entire watershed) with no concentration of disturbance in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area (except AMAs), 15% retention of LSOG in watershed [k]	<15% ECA (entire watershed) but disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area (except AMAs), 15% retention of LSOG in watershed [k]	>15% ECA (entire watershed) and disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; does not meet NWFP standard for LSOG retention
	Riparian reserves	The riparian reserve system provides adequate shade, large woody debris recruitment, and habitat protection and connectivity in all subwatersheds, and buffers or includes known refugia for sensitive aquatic species (>80% intact),and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/ composition >50% [m]	Moderate loss of connectivity or function (shade, LWD recruitment, etc.) of riparian reserve system, or incomplete protection of habitats and refugia for sensitive aquatic species (70-80% intact), and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/composition 25-50% or better [m]	Riparian reserve system is fragmented, poorly connected, or provides inadequate protection of habitats and refugia for sensitive aquatic species (<70% intact), and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/composition <25% [m]

[a] The ranges of criteria presented here are not absolute; they may be adjusted for unique watersheds.
[b] Bjornn, T.C. and D.W. Reiser, 1991. Habitat Requirements of Salmonids in Streams. American Fisheries Society Special Publication 19:83-138. Meehan, W.R., ed.
[c] Biological Opinion on Land and Resource Management Plans for the: Boise, Challis, Nez Perce, Payette, Salmon, Sawtooth, Umatilla, and Wallowa-Whitman National Forests. March 1, 1995.
[d] Washington Timber/Fish Wildlife Cooperative Monitoring Evaluation and Research Committee, 1993. Watershed Analysis Manual (Version 2.0). Washington Department of Natural Resources.
[e] Biological Opinion on Implementation of Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH). National Marine Fisheries Service, Northwest Region, January 23, 1995.
[f] A Federal Agency Guide for Pilot Watershed Analysis (Version 1.2), 1994.
[g] USDA Forest Service, 1994. Section 7 Fish Habitat Monitoring Protocol for the Upper Columbia River Basin.
[h] Frissell, C.A., Liss, W.J., and David Bayles, 1993. An Integrated Biophysical Strategy for Ecological Restoration of Large Watersheds. Proceedings from the Symposium on Changing Roles in Water Resources Management and Policy, June 27-30, 1993 (American Water Resources Association), pp. 449–456.
[I] Wemple, B.C., 1994. Hydrologic Integration of Forest Roads with Stream Networks in Two Basins, Western Cascades, Oregon. M.S. Thesis, Geosciences Department, Oregon State University.
[j] e.g., see Elk River Watershed Analysis Report, 1995. Siskiyou National Forest, Oregon.
[k] Northwest Forest Plan, 1994. Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. USDA Forest Service and USDI Bureau of Land Management.
[l] USDA Forest Service, 1993. Determining the Risk of Cumulative Watershed Effects Resulting from Multiple Activities.
[m] Winward, A.H., 1989 Ecological Status of Vegetation as a base for Multiple Product Management. Abstracts 42nd annual meeting, Society for Range Management, Billings MT, Denver CO: Society For Range Management: p. 277.
[n] No reference available.

Table 9-5. NOAA Fisheries checklist for documenting environmental baseline and effects of proposed action(s) on relevant indicators.

Pathways Indicators	Environmental Baseline			Effects of the Action(s)		
	Properly [a] Functioning	At Risk [a]	Not Properly [a] Functioning	Restore [b]	Maintain [c]	Degrade [d]
Water Quality						
Temperature						
Sediment						
Chem. contam./nutrients						
Habitat Access						
Physical barriers						
Habitat Elements						
Substrate						
Large woody debris						
Pool frequency						
Pool quality						
Off-channel habitat						
Refugia						
Channel Cond. & Dynamics						
Width/depth ratio						
Stream bank condition						
Floodplain connectivity						
Flow/Hydrology						
Peak/base flows						
Drainage network increase						
Watershed Conditions						
Road density & location						
Disturbance history						
Riparian reserves						

[a] These three categories of function (*properly functioning*, *at risk*, and *not properly functioning*) are defined for each indicator in the matrix of pathways and indicators (Table 9-4).

[b] For the purposes of this checklist, *restore* means to change the function of an *at risk* indicator to *properly functioning*, or to change the function of a *not properly functioning* indicator to *at risk* or *properly functioning* (i.e., it does not apply to *properly functioning* indicators).

[c] For the purposes of this checklist, *maintain* means that the function of an indicator does not change (i.e., it applies to all indicators regardless of functional level).

[d] For the purposes of this checklist, *degrade* means to change the function of an indicator for the worse (i.e., it applies to all indicators regardless of functional level). In some cases, a *not properly functioning* indicator may be further worsened, and this should be noted.

Table 9-6. USFWS matrix of diagnostics—pathways and indicators.

Diagnostic or Pathway	Indicators	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Species				
Subpopulation characteristics within subpopulation watersheds	Subpopulation size	Mean total subpopulation size or local habitat capacity greater than several thousand individuals. All life stages evenly represented in subpopulation. [b]	Adults in subpopulation are less than 500 but >50. [b]	Adults in subpopulation has less than 50. [b]
	Growth and survival	Subpopulation has the resilience to recover from short-term disturbances (e.g., catastrophic events), or subpopulation declines within one to two generations (5 to 10 years). [b] Subpopulation is characterized as increasing or stable. At least 10+ years of data support this estimate. [c]	When disturbed, the subpopulation will not recover to predisturbance conditions within one generation (5 years). Survival or growth rates have been reduced from those in the best habitats. The subpopulation is reduced in size, but the reduction does not represent a long-term trend. [b] At least 10+ years of data support this characterization. [c] If less data is available and a trend cannot be confirmed, a subpopulation will be considered at risk until enough data is available to accurately determine its trend.	The subpopulation is characterized as in rapid decline or is maintaining at alarmingly low numbers. Under current management, the subpopulation condition will not improve within two generations (5 to 10 years). [b] This is supported by a minimum of 5+ years of data.
	Life history diversity and isolation	Migratory form is present, and subpopulation exists near other spawning and rearing groups. Migratory corridors and rearing habitat (lake or larger river) are in good to excellent condition for the species. Neighboring subpopulations are large, with high likelihood of producing surplus individuals or straying adults that mix with other subpopulation groups. [b]	The migratory form is present but the subpopulation is not close to other subpopulations or habitat disruption has produced a strong correlation among subpopulations that do exist in proximity to each other. [b]	The migratory form is absent and the subpopulation is isolated to the local stream or a small watershed not likely to support more than 2,000 fish. [b]
	Persistence and genetic integrity	Connectivity is high among multiple subpopulations (five or more) with at least several thousand fish each. Each relevant subpopulation has low risk of extinction. [b] Probability of hybridization or displacement by competitive species is low to nonexistent.	Connectivity among multiple subpopulations does occur, but habitats are more fragmented. Only one or two of the subpopulations represent most of the fish production. [b] The probability of hybridization or displacement by competitive species is imminent, although few documented cases have occurred.	Little or no connectivity remains for refounding subpopulations in low numbers, in decline, or nearing extinction. Only a single subpopulation or several local populations that are very small or that otherwise are at high risk remain. [b] Competitive species readily displace bull trout. The probability of hybridization is high and documented cases have occurred.

Table 9-6. USFWS matrix of diagnostics—pathways and indicators (continued)**.**

Diagnostic or Pathway	Indicators	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Habitat				
Water quality	Temperature	7-day average maximum temperature in a reach during these life history stages: [b,d] Incubation 2 – 5ºC Rearing 4 – 12ºC Spawning 4 – 9ºC Also, temperatures do not exceed 15ºC in areas used by adults during migration (no thermal barriers).	7 day average maximum temperature in a reach during the following life history stages:[b, d] Incubation <2ºC or 6ºC Rearing <4ºC or 13 - 15ºC Spawning <4ºC or 10ºC Also, temperatures in areas used by adults during migration sometimes exceeds 15ºC.	7 day average maximum temperature in a reach during the following life history stages: [b, d] Incubation <1ºC or >6ºC Rearing >15ºC Spawning <4ºC or > 10ºC also temperatures in areas used by adults during migration regularly exceed 15 C (thermal barriers present).
	Sediment (in areas of spawning & incubation; address rearing areas under *substrate embeddedness*)	Similar to chinook salmon,[b] for example: <12% fines (<0.85 mm) in gravel,[e] ≤20% surface fines ≤6 mm. [f,g]	Similar to chinook salmon: [b] e.g., 12-17% fines (<0.85mm) in gravel, [e] e.g., 12-20% surface fines. [h]	Similar to chinook salmon [b]: e.g., >17% fines (<0.85mm) in gravel;[e] e.g., >20% fines at surface or depth in spawning habitat. [h]
	Chemical contamination & nutrients	Low levels of chemical contamination from agricultural, industrial, and other sources; no excess nutrients; no Clean Water Act 303(d) designated reaches. [i]	Moderate levels of chemical contamination from agricultural, industrial and other sources, some excess nutrients, one Clean Water Act 303(d) designated reach. [i]	High levels of chemical contamination from agricultural, industrial and other sources, high levels of excess nutrients, more than one Clean Water Act 303(d) designated reach. [i]
Habitat access	Physical barriers (address subsurface flows impeding fish passage under *flow/hydrology*)	Manmade barriers present in watershed allow upstream and downstream fish passage at all flows.	Manmade barriers present in watershed do not allow upstream and/or downstream fish passage at base/low flows	Manmade barriers present in watershed do not allow upstream and/or downstream fish passage at a range of flows.
Habitat elements	Substrate embeddedness in rearing areas (address spawning & incubation areas under the indicator *sediment*)	Reach embeddedness <20%. [j,k]	Reach embeddedness 20-30%. [j,k]	Reach embeddedness >30%. [e,k]
	Large woody debris (LWD)	Current values being maintained at: On the coast, >80 pieces/mile (>24-inch diameter, >50 ft length), [j] On the east side, >20 pieces/mile (>12-inch diameter, >35 ft length). [l] Adequate woody debris sources available for long- and short-term recruitment.	Current levels are being maintained at minimum levels desired for "functioning appropriately", but potential sources for long term woody debris recruitment are lacking to maintain these minimum values.	Current levels are not at those desired values for "functioning appropriately", and potential sources of woody debris for short and/or long term recruitment are lacking.

Table 9-6. USFWS matrix of diagnostics—pathways and indicators (continued)**.**

Diagnostic or Pathway	Indicators	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Habitat elements (continued)	Pool frequency & quality	Pool frequency in a reach closely approximates [f]: Wetted width (ft) # pools/mile 0–5 39 5–10 60 10–15 48 15–20 39 20–30 23 30–35 18 35–40 10 40–65 9 65–100 4 (can use formula: pools/mi = 5,280/wetted channel width #channel widths per pool); also, pools have good cover and cool water[e], and only minor reduction of pool volume by fine sediment	Pool frequency is similar to values in "functioning appropriately", but pools have inadequate cover/temperature[e], and/or there has been a moderate reduction of pool volume by fine sediment	Pool frequency is considerably lower than values desired for "functioning appropriately"; also cover/temperature is inadequate[e], and there has been a major reduction of pool volume by fine sediment
	Large pools (in rearing, adult holding, & overwintering reaches of >3 meters in wetted width at base flow)	Each reach has many large pools >1 meter deep. [e]	Reaches have few large pools (>1 meter) present[e]	Reaches have no deep pools (>1 meter)[e]
	Off-channel habitat (see reference 18 for identification of these characteristics)	Watershed has many ponds, oxbows, backwaters, and other off-channel areas with cover; and side-channels are low energy areas.[e]	Watershed has some ponds, oxbows, backwaters, and other off-channel areas with cover; but side-channels are generally high-energy areas[e]	Watershed has few or no ponds, oxbows, backwaters, or other off-channel areas[e]
	Refugia (see checklist footnotes for definition of this indicator)	Habitats capable of supporting strong and significant populations are protected and are well distributed and connected for all life stages and forms of the species.[m, n]	Habitats capable of supporting strong and significant populations are insufficient in size, number and connectivity to maintain all life stages and forms of the species[m, n]	Adequate habitat refugia do not exist[m]
Channel condition & dynamics	Average wetted width/ maximum depth ratio in scour pools in a reach	$\leq$10[h, f]	11–20[f]	>20[f]
	Stream bank condition	>80% of any stream reach has $\geq$90% stability.[f]	50–80% of any stream reach has $\geq$90% stability[f]	<50% of any stream reach has $\geq$90% stability[f]

Table 9-6. USFWS matrix of diagnostics—pathways and indicators (continued)**.**

Diagnostic or Pathway	Indicators	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Channel condition & dynamics (continued)	Floodplain connectivity	Off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession.	Reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession	Severe reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas; wetland extent drastically reduced and riparian vegetation/succession altered significantly
Flow/hydrology	Change in peak & base flows	Watershed hydrograph indicates peak flow, base flow and flow timing characteristics comparable to an undisturbed watershed of similar size, geology, and geography.	Some evidence of altered peak flow, base flow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography	Pronounced changes in peak flow, base flow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography
	Increase in drainage network	Zero or minimum increases in active channel length correlated with human caused disturbance.	Low to moderate increase in active channel length correlated with human caused disturbance	Greater than moderate increase in active channel length correlated with human caused disturbance
Watershed conditions	Road density and location	<1 mi/mi², [n] no valley bottom roads.	1–2.4 mi/mi², [n] some valley bottom roads	>2.4 mi/mi² [n]; many valley bottom roads
	Disturbance history	<15% ECA of entire watershed with no concentration of disturbance in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area there is an additional criterion of 15% LSOG in watersheds. [o]	<15% ECA of entire watershed but disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area there is an additional criterion of 15% LSOG in watersheds. [o]	>15% ECA of entire watershed and disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; does not meet NWFP standard for LSOG
	Riparian conservation areas (RHCA – PACFISH and INFISH) (riparian reserves – Northwest Forest Plan)	The riparian conservation areas provide adequate shade, large woody debris recruitment, and habitat protection and connectivity in subwatersheds, and buffers or includes known refugia for sensitive aquatic species (>80% intact), and adequately buffer impacts on rangelands: percent similarity of riparian vegetation to the potential natural community/ composition >50%.[p]	Moderate loss of connectivity or function (shade, LWD recruitment, etc.) of riparian conservation areas, or incomplete protection of habitats and refugia for sensitive aquatic species (70–80% intact), and adequately buffer impacts on rangelands : percent similarity of riparian vegetation to the potential natural community/composition 25–50% or better. [p]	Riparian conservation areas are fragmented, poorly connected, or provides inadequate protection of habitats for sensitive aquatic species (<70% intact, refugia does not occur), and adequately buffer impacts on rangelands : percent similarity of riparian vegetation to the potential natural community/composition <25%[p]
	Disturbance regime	Environmental disturbance is short lived; predictable hydrograph, high quality habitat and watershed complexity providing refuge and rearing space for all life stages or multiple life-history forms. [b] Natural processes are stable.	Scour events, debris torrents, or catastrophic fire are localized events that occur in several minor parts of the watershed. Resiliency of habitat to recover from environmental disturbances is moderate.	Frequent flood or drought producing highly variable and unpredictable flows, scour events, debris torrents, or high probability of catastrophic fire exists throughout a major part of the watershed. The channel is simplified, providing little hydraulic complexity in the form of pools or side channels. [b] Natural processes are unstable.

Table 9-6. USFWS matrix of diagnostics—pathways and indicators (continued)**.**

Diagnostic or Pathway	Indicators	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Species and Habitat				
Integration of species and habitat conditions		High habitat quality and connectivity among subpopulations. Migratory form is present. Disturbance has not altered channel equilibrium. Fine sediments and other habitat characteristics influencing survival or growth are consistent with pristine habitat. Subpopulation has resilience to recover from short-term disturbance within one to two generations (5 to 10 years). Subpopulation fluctuating around an equilibrium or is growing. [b]	Fine sediments, stream temperatures, or the availability of suitable habitats have been altered and will not recover to predisturbance conditions within one generation (5 years). Survival or growth rates have been reduced from those in the best habitats. The subpopulation is reduced in size, but the reduction does not represent a long-term trend. The subpopulation is stable or fluctuating in a downward trend. Connectivity among subpopulations occurs but habitats are more fragmented. [b]	Cumulative disruption of habitat has resulted in a clear declining trend in the subpopulation size. Under current management, habitat conditions will not improve within two generations (5 to 10 years). Little or no connectivity remains among subpopulations. The subpopulation survival and recruitment responds sharply to normal environmental events. [b]

[a] The values of criteria presented here are not absolute; they may be adjusted for local watersheds given supportive documentation.
[b] Rieman, B.E. and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. USDA Forest Service, Intermountain Research Station, Boise, ID.
[c] Rieman, B.E. and D.L. Meyers. 1997. Use of redd counts to detect trends in bull trout (*Salvelinus confluentus*) populations. Conservation Biology 11(4): 1015-1018.
[d] Buchanan, D.V. and S.V. Gregory. 1997. Development of water temperature standards to protect and restore habitat for bull trout and other cold water species in Oregon. In W.C. Mackay, M.K. Brewin, and M. Monita, eds. Friends of the Bull Trout Conference Proceedings. P8.
[e] Washington Timber/Fish Wildlife Cooperative Monitoring Evaluation and Research Committee, 1993. Watershed Analysis Manual (Version 2.0). Washington Department of Natural Resources.
[f] Overton, C.K., J.D. McIntyre, R. Armstrong, S.L. Whitewell, and K.A. Duncan. 1995. User's guide to fish habitat: descriptions that represent natural conditions in the Salmon River Basin, Idaho. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Gen Tech. Rep. INT-GTR-322.
[g] Overton, C.K., S.P. Wollrab, B.C. Roberts, and M.A. Radko. 1997. R1/R4 (Northern/Intermountain regions) Fish and Fish Habitat Standard Inventory Procedures Handbook. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Gen Tech. Rep. INT-GTR-346.
[h] Biological Opinion on Land and Resource Management Plans for the: Boise, Challis, Nez Perce, Payette, Salmon, Sawtooth, Umatilla, and Wallowa-Whitman National Forests. March 1, 1995.
[I] A Federal Agency Guide for Pilot Watershed Analysis (Version 1.2), 1994.
[j] Biological Opinion on Implementation of Interim Strategies for Managing Anadromous Fish-Producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH). National Marine Fisheries Service, Northwest Region, January 23, 1995.
[k] Shepard, B.B., K.L. Pratt, and P.J. Graham. 1984. Life Histories of Westslope Cutthroat and Bull Trout in the Upper Flathead River Basin, MT. U.S. Environmental Protection Agency report. Contract No. R008224-01-5.
[l] Interior Columbia Basin Ecosystem Management Project Draft Environmental Impact Statement and Appendices.
[m] Frissell, C.A., Liss, W.J., and David Bayles, 1993. An Integrated Biophysical Strategy for Ecological Restoration of Large Watersheds. Proceedings from the Symposium on Changing Roles in Water Resources Management and Policy, June 27-30, 1993 (American Water Resources Association), p. 449-456.
[n] Lee, D.C., J.R. Sedell, B.E. Rieman, R.F. Thurow, J.E. Williams and others. 1997. Chapter 4: Broadscale Assessment of Aquatic Species and Habitats. In T.M. Quigley and S.J. Arbelbide eds. An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins Volume III. U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management, Gen Tech Rep PNW-GTR-405.
[o] ECA = equivalent clear-cut area. LSOG = late-stage old growth. NWFP = Northwest Forest Plan.
Northwest Forest Plan. 1994. Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl. USDA Forest Service and USDI Bureau of Land Management.
[p] Winward, A.H., 1989 Ecological Status of Vegetation as a Base for Multiple Product Management. Abstracts 42nd annual meeting, Society for Range Management, Billings MT, Denver CO: Society For Range Management: p. 277.

Table 9-7. USFWS checklist for documenting environmental baseline and effects of proposed action(s) on relevant indicators.

Diagnostics/ Pathways: Indicators	Population and Environmental Baseline (list values or criteria and supporting documentation)			Effects of the Action(s)			
	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk	Restore [a]	Maintain [b]	Degrade [c]	Compliance with ACS
Subpopulation Characteristics:							
Subpopulation size							
Growth & survival							
Life history diversity & isolation							
Persistence & genetic integrity							
Water Quality:							
Temperature							
Sediment							
Chemical contaminants & nutrients							
Habitat Access:							
Physical barriers							
Habitat Elements:							
Substrate embeddedness							
Large woody debris							
Pool frequency & quality							
Large pools							
Off-channel habitat							
Refugia [d]							
Channel Conditions & Dynamics:							
Wetted width/max depth ratio							
Stream bank condition							
Floodplain connectivity							
Flow/Hydrology:							
Change in peak & base flows							
Drainage network increase							
Watershed Conditions:							
Road density & location							
Disturbance history							
Riparian conservation areas							
Disturbance regime							
Integration of Species & Habitat Conditions							

[a] For the purposes of this checklist, *restore* means to change the function of a *functioning at risk* indicator to *functioning appropriately*, or to change the function of a *functioning at unacceptable risk* indicator to *functioning at risk* or *functioning appropriately* (i.e., it does not apply to *functioning appropriately* indicators). Restoration from a worse condition to a better condition does not negate the need to consult or confer if *take* will occur.

[b] For the purposes of this checklist, *maintain* means that the function of an indicator does not change (i.e., it applies to all indicators regardless of functional level).

[c] For the purposes of this checklist, *degrade* means to change the function of an indicator for the worse (i.e., it applies to all indicators regardless of functional level). In some cases, a *functioning at unacceptable risk* indicator may be further worsened, and this should be noted.

[d] Refugia = watersheds or large areas with minimal human disturbance having relatively high quality water and fish habitat, or having the potential of providing high quality water and fish habitat with the implementation of restoration efforts. These high quality water and fish habitats are well distributed and connected within the watershed or large area to provide for both biodiversity and stable populations.

(Adapted from discussions in *Stronghold Watersheds and Unroaded Areas* in Lee, D.C., J.R. Sedell, B.E. Rieman, R.F. Thurow, J.E. Williams, and others. 1997. Chapter 4: *Broadscale Assessment of Aquatic Species and Habitats*. *In* T.M. Quigley and S.J. Arbelbide eds. *An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins*, Volume III. U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management, Gen Tech Rep PNW-GTR-405).

10.0 Indirect Effects

10.0 Indirect Effects

Chapter Summary

- Three common kinds of indirect effect are:

  1. Changes to ecological systems resulting in altered predator/prey relationships

  2. Changes to ecological systems resulting in long-term habitat alteration

  3. Anticipated changes in human activities, including changes in land use.

- When conducting an indirect effects analysis for anticipated changes in land use, there are ten questions to address:

  1. Does the project create a new facility (e.g., new road or new interchange) or increase the capacity of the existing system?

  2. Is new development contingent on the transportation project (i.e., would not occur without the project)?

  3. Is any development caused by or dependent on the project?

  4. Reevaluate the size and location of the action area.

  5. Are proposed or listed species or designated critical habitat present within the action area?

  6. If development is contingent or dependent on the project, what potential impacts on the species and habitat will result from the development?

  7. What rules or measures are incorporated into the project to help minimize these potential effects?

  8. If development is contingent or dependent on the project, how will this development affect the environmental baseline conditions?

  9. If development is contingent or dependent on the project, will this development have potential effects on the species?

  10. If development is contingent or dependent on the project, is this development likely to adversely affect the species or critical habitat?

10.1 General Considerations

Assessing the indirect effects of a proposed project can be a daunting task in that extensive research efforts may be required to complete a comprehensive analysis of these effects. This chapter provides general guidance and specific WSDOT guidance for analyzing indirect effects. The discussion is followed by writing samples that illustrate how indirect effects may be effectively addressed in BAs.

Indirect effects are those impacts that are caused by the action and occur later in time (after the action is completed) but are still reasonably certain to occur. The geographic extent of indirect effects of the proposed action and any interrelated or independent activities is one component defining the project action area. Examples of interrelated or interdependent activities include phased or staged projects along one roadway, or several projects constituting elements of a single municipal or regional program or plan. Three common kinds of indirect effects associated with transportation projects include:

- Changes to ecological systems resulting in altered predator/prey relationships
- Changes to ecological systems resulting in long-term habitat alteration
- Anticipated changes in human activities including changes in land use. This may include the development of undeveloped areas that is induced by the action or can reasonably be expected to result from the action.

If a project significantly affects the prey species of a listed species, this impact is considered an indirect effect upon the listed species. The analysis of the extent of this indirect impact should emphasize the impact of the project on the *population* of the prey species. For example, if a project significantly affects the population of coho salmon in a stream within a watershed identified by USFWS as a bull trout spawning subwatershed, this impact is an indirect effect upon the bull trout population in the subwatershed.

A project can have long-term effects upon the habitat of a listed species. If a project removes riparian vegetation and does not compensate for this loss, the habitat functions provided by this vegetation will also be lost. If a project will increase ambient noise levels in the vicinity of the project, habitat that was once suitable for sensitive species may be rendered unsuitable. If a project changes the hydrology of wetlands that sustain essential prey or forage species or provide suitable habitat or important habitat features for a sensitive species, the wetland habitat upon which the species depends may be altered to the point that it is no longer suitable habitat for the species.

In more complex cases, determining the action area for a transportation project may require an understanding of the history of the project in relation to other actions in its vicinity, and an analysis of surface water, traffic patterns, and local land development. Appropriate expertise in traffic engineering, transportation and land use planning, and other areas may be needed in order to define the action area.

The project biologist should consider the following topics to ensure that indirect effects related to land use are adequately addressed and that the action area is properly defined:

- Does the proposed project create a new roadway or transportation facility?
- Does the project increase the capacity of the transportation or roadway system, which in turn may influence the rate of development in surrounding areas (e.g., construction of roads)?
- Does the project provide access to an area that was not previously accessible, thus influencing human activity levels, land use, and potential impacts in the area (e.g., construction of interchanges)?
- Is new development contingent on the proposed project (e.g., construction of roads)? (In some cases, developments are tied to certain transportation improvements by permit conditions, building moratoriums, or Growth Management Act concurrency requirements.)
- Is new development caused by or dependent upon (and therefore an effect of) the transportation project? Are any activities such as residential and commercial development or other land use changes likely to result from the project? (Land development can be driven by a variety of social and economic factors, in addition to the provision of access, which may or may not be directly related to the project.)

These topics are addressed in the WSDOT guidance section that follows, which includes writing samples appropriate for indirect effects analysis sections.

10.2 WSDOT Guidance—ESA, Transportation, and Development: Assessing Indirect Effects

Under the Endangered Species Act, federal agencies must consult with NOAA Fisheries and USFWS to determine the effects of federal project actions on threatened and endangered species. WSDOT is designated to consult on behalf of FHWA for informal consultations.

The consultation process includes an analysis of direct and indirect effects of the action, as well as the effects of any interrelated or interdependent activities, on listed species. During the Section 7 consultation, questions may arise regarding the relationship of a transportation project to development in adjacent or nearby areas and whether such development is considered an *indirect effect* as defined under the ESA. This document provides general guidance for reviewing and analyzing only the indirect effect relationship between transportation and land use development during the consultation process. Other types of transportation project effects that require analysis are not addressed here. Note that WSDOT and FHWA are not required by Section 7 to mitigate the indirect effects of an action.

10.2.1 Background

Within the state of Washington, development is managed through the Growth Management Act (GMA). The law requires that infrastructure investments (not just transportation investments, but water supply, sewage treatment, parks, and schools) must be adequate to serve a development at the time the development is available for occupancy without decreasing current service levels below locally established minimum standards.

> *"Concurrent with the development" shall mean that improvements or strategies are in place at the time of development, or that a financial commitment is in place to complete the improvements or strategies within 6 years* (RCW 36.70A.070 Comprehensive Plans – Mandatory Elements).

An important component of the Growth Management Act is the designation of *urban growth areas* to accommodate urban growth 20 years into the future, to restrict the advance of urban sprawl into rural areas, and to protect resource lands. The designation of urban growth areas may increase the intensity of commercial and residential land uses and the density of development, thereby creating the opportunity for alternative travel options (e.g., rail, bus, carpool/vanpool, and bicycle/pedestrian modes), as well as reducing the need for and cost of extending infrastructure beyond the urban growth boundary.

Another important component of the Growth Management Act is the protection of critical areas, which include wetlands, frequently flooded areas, aquifer recharge zones, geologically hazardous areas, and fish and wildlife conservation areas. The law requires that local jurisdictions designate and protect these critical areas by ordinance.

The Growth Management Act was amended in 1995 to require that counties and cities "*include the best available science in developing policies and development regulations to protect the functions and values of critical areas. . . . In addition, counties and cities shall give special consideration to conservation or protection measures necessary to preserve or enhance anadromous fisheries*." This amendment provides the direction for jurisdictions with weak critical area protections to do more. The need for including good science has become a requirement as fish recovery is implemented under the Endangered Species Act. Also, counties and cities were required to review and, if necessary, revise their plans and regulations by September 1, 2002, to be consistent with the statute and its amendments. However, consistency with critical area regulations developed under the Growth Management Act does not necessarily ensure that a project will not result in indirect effects on listed species or critical habitat.

10.2.2 Guidance for Preparing Biological Assessments

This guidance has resulted from discussions among the USFWS, NOAA Fisheries, FHWA, Office of Community Development, and WSDOT, with input from local agencies and stakeholder groups, in 1999 and 2000. It was updated in 2003 as a result of coordination with NOAA Fisheries, USFWS, FHWA, and WSDOT. The guidance provides general recommendations for the consideration of indirect effects in biological assessments prepared for ESA Section 7 consultations on transportation projects. The intent is to provide a framework to facilitate the appropriate treatment of indirect effects in a biological assessment. This guidance is expected to be an evolving document; as understanding of biological aspects of indirect effects increases, more definitive recommendations may result.

This document describes a step-by-step approach to assess indirect effects by posing a series of questions about the proposed project. These are shown graphically with a decision-making flowchart, reproduced here in Figure 10-1, and explained in the text that follows. Table 10-1 gives examples of project types, potential land use changes, and the level of assessment usually required in a BA.

This guidance pertains only to indirect effects. It is assumed that any project undergoing Section 7 consultation is also evaluated for direct effects, using ESA regulations and other guidance.

General guidance on indirect effects and ESA consultation are also found in *ESA Section 7 Consultation Handbook*, March 1998, pages 4-27 to 4-29. This guidance is not intended for NEPA cumulative effects analysis; while there is some overlap with ESA consultation, there are important distinctions between the two regulatory processes.

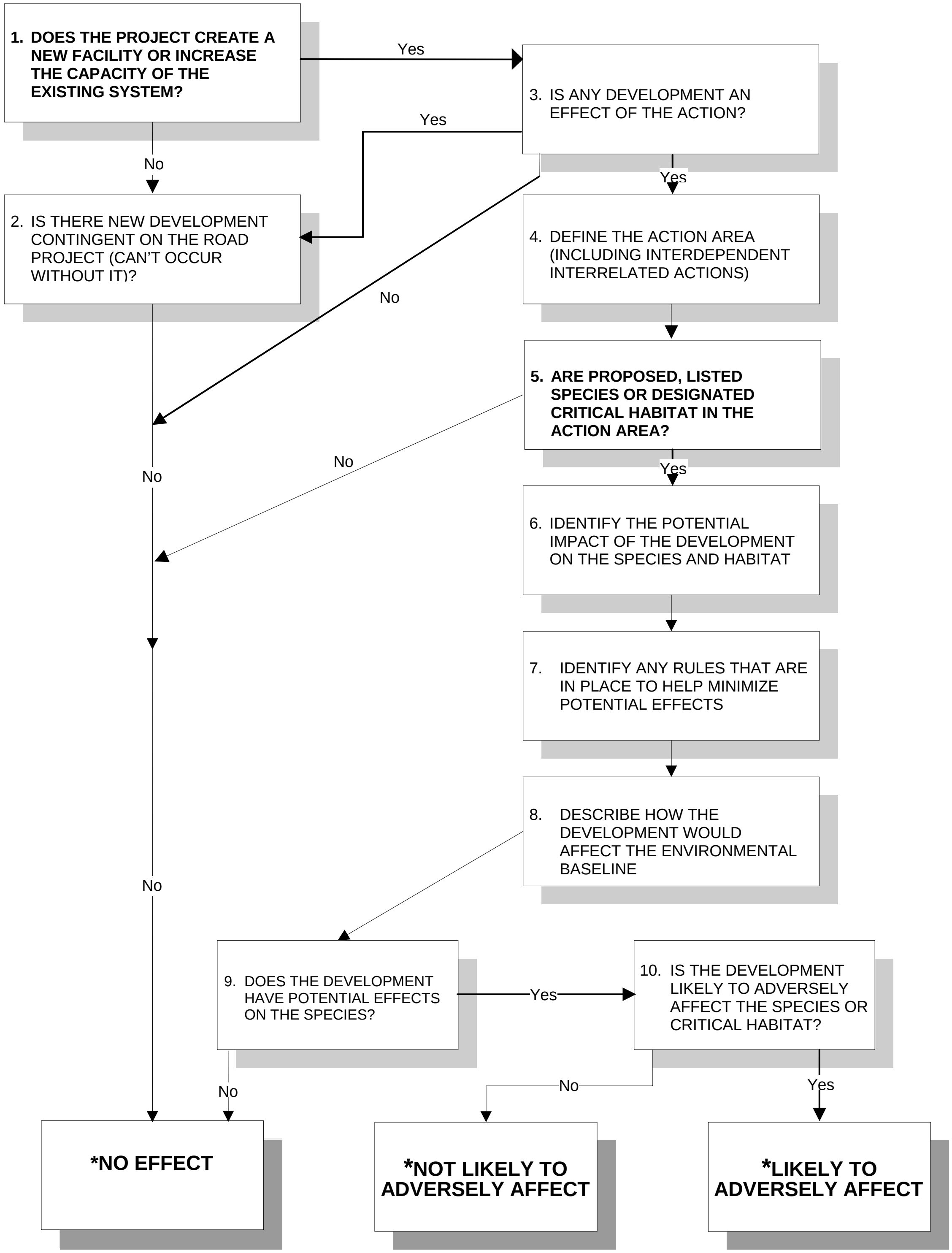
10.2.2.1 Definitions

The Action

Analysis for ESA consultation must address the proposed action, including any interrelated and interdependent actions. Interrelated actions are those that are part of the larger action and dependent on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration.

The Effect

According to ESA rules and regulations, *direct effects* occur at or very close to the time of the action itself. Examples include construction noise disturbance, loss of habitat, or sedimentation that results from construction activity. *Indirect effects* are those that are caused by the action and are later in time (after the action is completed) but still reasonably certain to occur. Examples include changes to ecological systems, such as predator/prey relationships, long-term habitat changes, or anticipated changes in human activities, including changes in land use. The geographic extent of these effects is the *action area*, defined as all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action.



*This process is for the assessment of indirect effects only and presumes that the project is analyzed for direct effects before a final effect determination is made.

Figure 10-1. Indirect effect determinations based on transportation and land development.

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Table 10-1. Project screening for indirect effects and effect calls in light of indirect effects.

Project Category	Project Description	Potential Land Use Changes	Analysis Need for BA	Effect Call (Considering Indirect Effects Only)
Design standards upgrade	Improve roadway design to engineering standards for lane width, curb, gutter and sidewalk, and other geometrics.	Very limited potential to cause land use change	Assessment in BA that details why project will not result in indirect effects.	Mostly NE
Operations and safety improvements	Make improvements to enhance traffic operations and safety including signalization, traffic control, channelization, median treatments, turn pockets/lanes, and other benefits to traffic flow.	Usually insignificant potential to cause land use change	Assessment in BA that details why project has insignificant potential to result in indirect effects.	Mostly NE
Pavers (preservation)	Repave road surface without providing an increase in capacity.	No potential to cause land use change	Assessment in BA that details why project has insignificant potential to result in indirect effects.	Mostly NE
Bridge replacement	Replacing bridges without providing an increase in capacity.	Very limited potential to cause land use change	Assessment in BA that details why project has insignificant potential to result in indirect effects.	Mostly NE
Increased lane capacity, improvements to existing interchanges	Add physical through-lane capacity to an existing roadway.	Potential to cause land use change	Detailed analysis of indirect effects	NLTAA or LTAA, depending on specific impacts
Roadway extension, new roadway, new interchange	Construct extension of roadway, or new roadway on new alignment.	Potential to cause land use change	Detailed analysis of indirect effects	NLTAA or LTAA, depending on specific impacts

NE = no effect; NLTAA = not likely to adversely affect; LTAA = likely to adversely affect.

Indirect effects of transportation projects include changes in land use, such as the development of undeveloped areas when those changes are induced by the action or can reasonably be expected to result from the action.

10.2.3 Indirect Effect Evaluation Process

1. Does the project create a new facility (e.g., new road or new interchange) or increase the capacity of the existing system?

This step identifies the types of transportation improvements that have the potential to influence land use.

New capacity is defined as an increased ability for the transportation system to handle traffic volumes. New roadways or significant changes in capacity or land access have the potential for indirect effects on listed species and their habitat, because these changes potentially cause changes in land development by altering access to land. Other examples are the addition of lanes to a roadway, or the creation of new land access (such as new intersections or interchanges) from an existing road. New interchanges on limited-access roads may lead to changes in land development, but upgrading an existing intersection with a new interchange generally has very limited or no effect on land use. These are generalities, and it is important to consider the specific facts of the project being evaluated. Other examples are given in Table 10-1.

Many transportation projects are intended to improve traffic flow, relieve congestion, or increase safety. Safety projects often include construction of auxiliary lanes (e.g., for turning, acceleration, or deceleration) on existing roadways, but these new lanes do not increase capacity. Because these projects generally improve operation of the transportation system but do not change the development potential of land, they are not likely to cause land use changes (this applies to many high-occupancy vehicle [HOV] projects that are primarily modal changes). For these types of projects, the indirect effects analysis may be brief. Otherwise, if a transportation project is anticipated to result in a land use change through significant change in land access or capacity improvement, then potential indirect effects on listed species and habitat should be identified and evaluated.

It can be unclear whether a project actually increases capacity or simply redistributes the same traffic in different ways. Land use and transportation planning and engineering expertise may help with this distinction and with the evaluation of likely impacts. Such expertise may also provide information about development patterns in the area and the impacts of comparable projects. When this issue is not reasonably clear, project proponents should confer with the Services in advance to agree on an approach before the completion of a BA.

BA Task: Determine whether proposed project creates a new facility or increases the capacity of the existing system.

> *Example:* WSDOT proposes to construct a new lane in either direction along SR 395 between I-90 and the Tri-Cities to relieve traffic congestion and improve safety. The project will also flatten horizontal curves and establish a divided highway, which will allow a speed limit increase from 55 mph to 65 mph. Between the speed limit increase and the additional lanes, the project will more than double the capacity along this highway segment. The project will not create a new facility, but it will increase the capacity of the existing system.

2. *Is new development in the vicinity contingent on the transportation project (i.e., would not occur without the project)?*

In some cases, a development is tied by a permit condition (or a building moratorium associated with Growth Management Act concurrency) to certain transportation improvements. In these cases, if the development could not proceed without the transportation improvement and is reasonably certain to result from it, the effects of the development must be considered as part of the indirect effects of the transportation action. These indirect effects must be addressed in the consultation for the project. However, from the perspective of concurrency with the Growth Management Act rather than ESA consultation, the new development is viewed as the driver. This makes the roadwork necessary as mitigation for the increased traffic caused by that new development. Although the development may be the actual cause of adverse effects on species, development in most cases does not involve a federal nexus and thus may not trigger Section 7 consultation on its own.

BA Task: Check with appropriate local agency public works or planning office to determine whether development projects in the area meet these criteria.

Relevant documents include the transportation element of the comprehensive plan, and the capital facilities plan. This is useful as documentation to support the analysis.

> *Example*: A road-widening project proposes to add two new lanes along Skinny Boulevard, an existing arterial. The project occurs within King County's transportation service area (TSA) 3 as identified in the county's comprehensive plan. The transportation service strategy within TSA 3 is "construct arterials to meet existing and future capacity needs." The county identifies the proposed project as one of several projects considered necessary to meet these future capacity needs. The project is also located in a transportation concurrency zone identified as over threshold where a development moratorium is in place until transportation infrastructure improvements are in place to adequately handle additional traffic. Upon review of the pending transportation concurrency applications, the approval of three development projects is dependent upon the completion of the proposed Skinny Boulevard road-widening project. Following this review, new development is clearly dependent on the completion of the proposed project.

3. Is any development in the vicinity caused by or dependent on the project?

This step identifies any activities that are likely to result from the proposed project, such as residential and commercial development or other land use changes.

This task is complicated by the present high rate of population growth and land development in many parts of Washington. In many cases, transportation projects are being constructed in the context of a developing landscape. Land development is driven by a variety of social and economic factors, in addition to the provision of access. It is difficult to isolate which of these factors are causal in a particular development. Road projects are often built in response to problems resulting from population growth, but only infrequently do they actually trigger the development itself. In most cases, land development generally is not caused by a transportation project, although transportation projects can in some cases influence the rate or type of development.

One approach to identify any land use change caused by a project is to look at existing zoning in areas potentially influenced by the project and consider the build and no-build scenarios for the road project. The distance from the project will vary with the individual situation. When development in a given area is planned under a no-build scenario, due to existing zoning or land use plans, it is not caused by the road project and is not considered an indirect effect of the road project. When a development is likely to occur only under the build scenario, then the road project may cause land use changes that are not likely to occur otherwise. In that case, the resulting development and land use change is an indirect effect of the project. Table 10-1 gives some examples for typical projects. While zoning does not constitute a certainty that development will occur without the project, it is reasonable to assume that land use will follow existing plans and zoning, unless there is evidence to the contrary.

In attempting to identify development that could be caused by a transportation project, the focus should be on actions that are reasonably certain to occur in the foreseeable future. Actions that are planned, designed, and developed according to NEPA guidance meet these criteria, but speculative projects probably do not.

BA Task: Seek expertise from planning, traffic engineering, or other areas to conduct this evaluation.

- Review the highway system plan and/or project definition file for the project to identify deficiencies the proposed transportation facility is intended to address.

- Review the comprehensive plan and zoning for the jurisdiction within which the project is located, to determine the relationship between the facility and land use designations, as well as consistency with the capital facilities plan and the transportation element of the comprehensive plan. Pending ordinances that will affect land uses, protected areas, etc., should be considered when specific actions are reasonably certain to occur in the foreseeable future (e.g., final adoption of an ordinance).

- Determine whether the facility is identified as needed infrastructure for planned growth in accordance with concurrency requirements of the plan and the Growth Management Act.

- If the facility is consistent with pertinent land use and transportation plans, then the analysis of effects may demonstrate that the facility is intended to serve planned growth.

The biological assessment should identify whether any areas or specific developments exist in which land use is expected to change as a result of the project. This determination can be made by checking with comprehensive plans and local zoning.

> *Example*: A new interchange and road extension proposed along SR 1 will be constructed between two existing highway interchanges (Figure 10-2). All of the

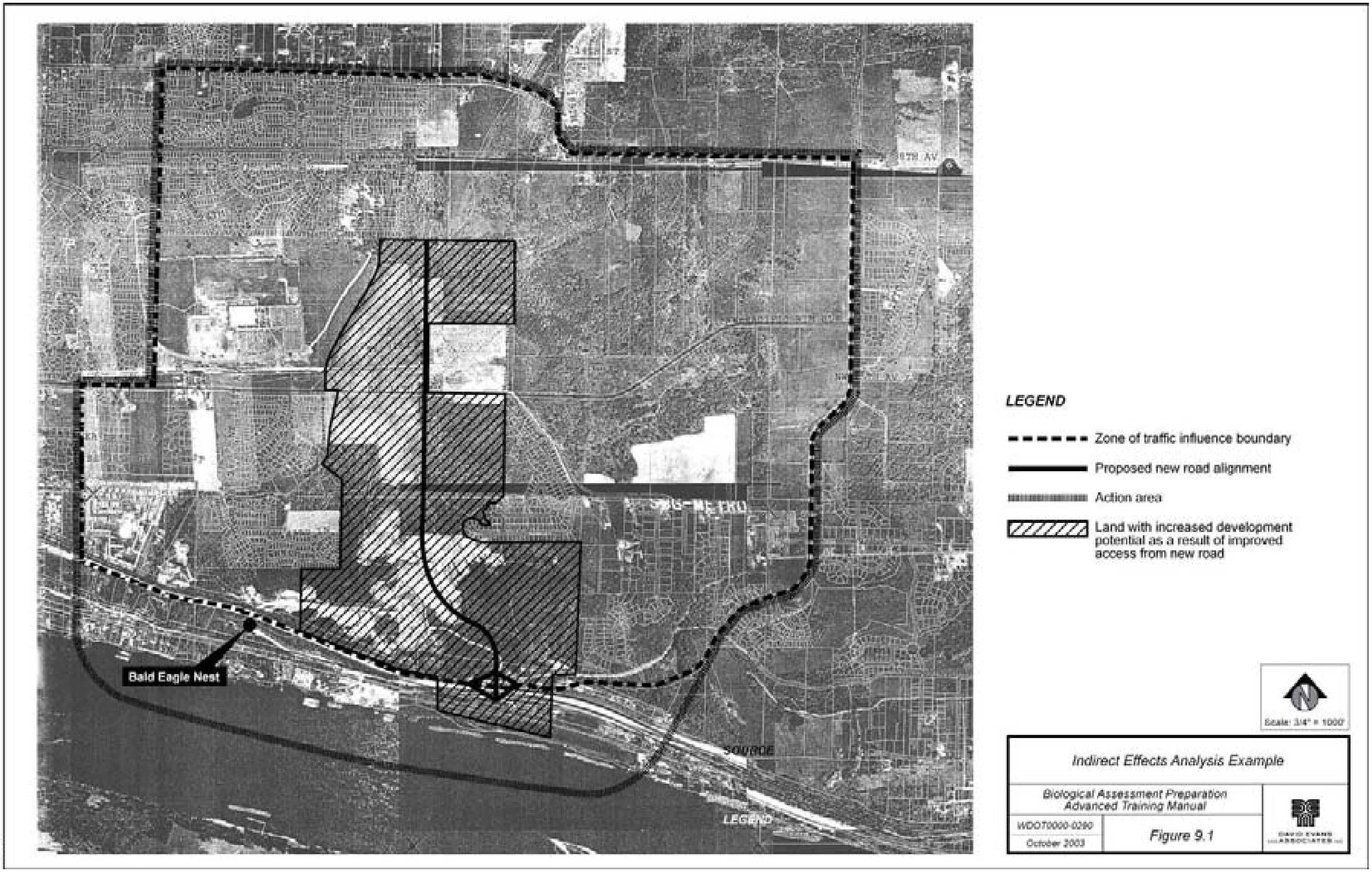

Figure 10-2. Example of a transportation project that has indirect effects on land use.

roads and adjoining lands that will be accessible from the new interchange are currently accessed from the two existing interchanges. However, the new interchange and road extension will likely result in improved freeway access to much of the area located between the existing interchanges. The project definition indicates that the existing SR 1 access points are insufficient in accommodating the anticipated future highway access needs in the service area.

The city's comprehensive plan identifies the area in the vicinity of the proposed new road and interchange as occurring within the city's urban growth boundary. The city's comprehensive plan identifies this area as a key area for growth because of its proximity to SR 1 and existing commercial centers. The comprehensive plan also identifies the need for improved transportation facilities as the primary limiting factor for growth in this area. As a result, the city has imposed traffic concurrency requirements for future development in this designated growth area.

These proposed improvements are consistent with the city's land use and transportation plans. The above information indicates that the proposed project is intended to serve planned growth.

The construction of the new interchange is proposed to improve access to and from SR 1. Although the proposed project will not provide access to currently inaccessible lands, the undeveloped parcels located along the proposed road extension may have greater development appeal as a result of the improved mobility in the vicinity that results from this project. In this case, development of these parcels may occur as a result of this project, or more likely, their development may occur sooner than it would occur without the completion of this project. Moreover, given the traffic concurrency requirements imposed for this area, future development cannot occur without the proposed transportation improvements.

4. Define the action area.

Indirect effects occur later in time than the original action and may occur outside the area directly affected by the action. The entire area evaluated in the BA for potential project effects on listed species is called the *action area*. When defining the action area it is important to include the areas that are both directly and indirectly affected by the proposed action. The extent of the action area is based on the physical, chemical, and biotic extent of the project effects.

In more complex cases, determining an action area for a transportation project may involve analysis of surface water, traffic patterns, and local land development. The project biologist may need to consult specialists in traffic engineering, transportation land use planning, and other areas in preparing the BA. The purpose is to determine whether a project may ultimately affect a listed species by affecting land use. Defining the action area can be complex for development-related indirect effects. An overly wide definition of the action area leads to more complexity for cumulative effects analysis and a potential to overestimate effects. This can create unnecessary complications, particularly for formal consultation. An undersized action area may fail to adequately characterize the extent of potential impacts. For the BA, the objective is to identify the geographic extent of the effect of land use changes that are caused by the action and that may ultimately affect listed species or their habitat. In some cases, the action area may not be a single contiguous area but rather a patchy distribution.

BA Task: Choose an appropriate method of defining the action area.

Several methods are suggested below for help in determining the action area. These may be tailored with respect to project specifics and the available information. Alternative methods may be used; however, an explanation of the method used may be necessary. Such alternatives should be discussed with the Services before significant work is undertaken.

Step 1: Characterize the potential zone of influence for change in traffic caused by the project.

a. The zone of influence for traffic could be estimated by using projected traffic volumes and focusing on any projected changes in traffic patterns due to the proposed action (i.e., the area accessed though a new interchange).

b. In some cases, the zone of influence for traffic could be generally defined as a corridor along the road, including the project, and continuing to the closest intersection with a major transportation route such as a state highway.

c. Existing planning units delineated in some jurisdictions as part of land use planning and traffic mitigation analysis could be used to define the action area, or in conjunction with subwatershed boundaries to define the action area.

d. Detailed analyses of traffic patterns such as origin-destination studies or other studies may be performed as part of planning for certain actions. These may be used where available from project planning materials.

Step 2: Factor in the watershed

To define the action area, overlay the traffic zone-of-influence boundary with the subwatershed (i.e., watershed administrative unit) that coincides. For aquatic species, the BA analysis should cover the geographic area defined by the overlap, plus any downstream portions of the subwatershed.

> *Example:* Under the SR 1 interchange scenario, the zone of influence includes all roads that will be affected by the new interchange. This area includes all locations where access to SR 1 is most direct or quickest using the new interchange, compared to the existing interchanges and the roads from which traffic would be diverted as a result of the proposed action (see Figure 10-2). The action area includes this zone of traffic influence as well as any surrounding area that could be affected by actions that occur as a result of the proposed

action. This includes a 0.5-mile buffer from lands where development is reasonably certain to occur as a result of the proposed action, to account for possible construction disturbance, as well as the farthest downstream distance where these future actions could affect water quality or hydrology (see Figure 10-2).

5. Are proposed or listed species or designated critical habitat present within the action area?

In most cases, the immediate project area probably includes designated critical habitat for salmonid evolutionarily significant units (ESUs), distinct population segments (DPSs), or other ranges of listed species. In some cases, a project might involve listed species only because of its indirect effects.

BA Task: Make certain that all listed species and critical habitat within the action area are included in the analysis.

Once the action area is determined, recheck the listing information to ensure that the species list is still adequate for the analysis. The species list should encompass the entire action area, not just the project area. Obtain additional species information if needed. The use of countywide species lists to start with is one way to avoid having to revisit a species list request.

> *Example*: If the action area as determined through the consideration of indirect effects is larger than the action area defined when only considering direct effects, this expanded action area could extend into the range or habitat associated with a listed species that would otherwise not occur within the smaller action area associated only with the direct effects.
>
> Using the SR 1 interchange/road extension example portrayed in Figure 10-2, the bald eagle nest is located over 0.5 miles from the proposed project and likely would be outside of the action area if indirect effects were not considered. However, when considering the potential indirect effects, the bald eagle nest is located within 1,000 feet of future development that would likely be induced by the project (see Figure 10-2). In this example, the bald eagle would probably be included on the species list from USFWS. However, as mentioned above, it is possible that the action area identified when considering indirect effects could extend into the range of species not included on the original species list that was generated based on the proposed project location.

6. If development is contingent or dependent on the project, what potential impacts to the species and habitat will result from the development?

The project biologist should evaluate the development in the action area that is contingent on or likely to occur because of the proposed project. This may include an evaluation of the local jurisdiction's comprehensive plan, likely project-dependent changes in the existing level of development, and likely project-dependent growth boundary changes. This information may be available through the local transportation planning agency.

The key question is whether there will be adverse effects on the species or its habitat. In addition to direct effects on listed species, consider potential impacts on aquatic habitats, adjacent riparian zones, downstream water quality, and properly functioning habitat conditions.

BA Task: Expand the analysis of effects to include effects of the development.

The analysis of the effects of the development should cover the same elements as the analysis of the original project, although it may be necessary to make estimates if future land use actions are involved.

> *Example:* Using the SR 1 interchange/road extension example portrayed in Figure 10-2, the indirect effects could result in three key forms of impact: 1) loss of habitat from future development dependent or caused by the proposed action, 2) increased disturbance from future construction and population growth that occurs as a result of the proposed action, and 3) water quality impacts from increased impervious surface and pollutant sources.
>
> In addition to direct impacts on habitat, impacts on habitat resulting from future development that could occur due to the proposed action could result in the loss of as much as 160 acres of mixed deciduous-coniferous forest and 100 acres of unforested land consisting of an abandoned gravel pit and fallow pasture.
>
> The active bald eagle nest identified in Figure 10-2 is located within 0.25 miles of a parcel of land where development could occur as a result of the proposed interchange construction. Suitable bald eagle perching and feeding habitat also occurs on and adjacent to this and other parcels located adjacent to the proposed interchange. Development of these parcels could result in the loss of bald eagle habitat within this active territory. Construction associated with the development of these parcels, as well as future land use activities, could result in increased disturbance to eagles in this nest territory and could lead to nest failure. Increased traffic at the proposed new interchange and road extension could also result in additional noise and visual disturbance to bald eagles.
>
> Based on the existing zoning of the parcels where development could occur as a result of the proposed action, as much as 80 acres of new impervious surface could be generated if each of these parcels is developed to their full density potential. This increase in impervious surface area could have an adverse effect on water quality and hydrology in the action area, in turn affecting listed salmonids that rear in the action area.

7. What rules or measures are in place to help minimize these potential effects?

The BA author should note any protection for listed species and habitat provided by existing local critical area ordinances in the action area. This may include protection for riparian or wetland buffers, stormwater regulations, and implementation and enforcement of existing critical area ordinances.

BA Task: Identify required conditions or measures that may prevent or minimize adverse effects.

The BA should address the following questions: What are the protective measures available to minimize project impacts? Are there factors that would help reduce or minimize the potential effect of development caused by the project? These might include plans or commitments by agencies or project proponents outside the critical area ordinances. Other protective regulations such as conditions of the hydraulic project approval (HPA) should be included where applicable. The results of this assessment should be incorporated into the discussion of the effects of the proposed action on the environmental baseline.

> *Example:* The local jurisdiction currently requires all development to provide treatment of stormwater consistent with the Department of Ecology stormwater manual. The local jurisdiction also has established a critical areas ordinance that regulates development in the vicinity of wetlands and streams. Depending on the class of stream or wetland, buffers ranging from 25 to 100 feet apply to these features. Any permissible unavoidable impacts on critical areas must be mitigated through the implementation of approved enhancement, creation, or restoration measures. All future land use actions are also subject to Section 9 of the Endangered Species Act, the Washington state hydraulic code, and state and federal bald eagle protection rules. Given these existing regulations, development that results from the proposed action will not significantly alter water quality, hydrology, streams, or wetlands, and is not likely to result in significant impacts on bald eagles.

8. If development is contingent or dependent on the project, how will this development affect the environmental baseline conditions?

The potential effects of the action should be compared to the environmental baseline conditions using the NMFS (1996) matrix of pathways and indicators guidance document and any appropriate guidance from USFWS. Measures in place to protect the species or habitat should be considered in this assessment.

BA Task: As part of the effect determination, describe the existing environmental baseline condition and describe how the direct and indirect effects of the action would likely affect it. Would indirect effects of the project degrade, maintain or improve the existing conditions?

9. If development is contingent or dependent on the project, will this development have potential effects on the species?

If the project has any effects on listed species or designated critical habitat, even small or temporary effects, then a biological assessment must be prepared and ESA Section 7 consultation is required.

BA Task: Combine this analysis with the evaluation of direct effects.

If no indirect effect resulting from any development is likely to result from the action, and there are no other direct or indirect effects, then the project as a whole will have *no effect*. Combine this analysis with the evaluation of direct effects and proceed with the appropriate *no effect* documentation for the project. Adequate information must be provided to explain and support the conclusions of the analysis.

If the project does have potential effects, then proceed with the biological assessment to determine if the effects are significant or discountable.

> *Example:* Because future development is dependent upon completion of the proposed SR 1 interchange/road extension project, the most notable indirect effects of the project include possible development in the vicinity of the interchange and along SR 1 that would not likely occur without the project. Other impacts include a potential accelerated rate of development of lands along the road extension, which will occur eventually, regardless of the proposed action. It is assumed that complete build-out within the action area will result sooner with the proposed project than without these roadway improvements, although this rate of acceleration cannot be quantified, given the difficult task of isolating this factor from the numerous other influences on development.
>
> Because development in the vicinity could affect bald eagle habitat and could result in disturbance to nesting bald eagles, the proposed action could indirectly result in increased impacts on bald eagles. However, the required compliance with existing state and federal laws pertaining to bald eagles will minimize these impacts. Because treatment of stormwater and development in and near critical areas is regulated by the local jurisdiction, indirect impacts on listed fish species and bald eagle are likely to be insignificant and discountable.

10. If development is contingent or dependent on the project, is this development likely to adversely affect the species or critical habitat?

In this step, a determination is made as to the significance of any potential effects on listed species or designated critical habitat. This differentiation will lead to either formal or informal consultation, based on whether the effect is considered insignificant or discountable (informal consultation) or adverse (formal consultation).

Insignificant effects are generally very small in scale, do not reach the level of *take* as defined by the ESA, and cannot be meaningfully measured, detected, or evaluated. *Discountable* effects are those that are extremely unlikely to occur.

An adverse effect is one that cannot be considered insignificant or discountable. If an action significantly degrades the baseline conditions, the Services may consider it an adverse effect. Actions that result in a *take* of individuals or that modify critical habitat are considered to adversely affect the species under consideration. The extent of any adverse effect is considered in the consultation.

BA Task:

If the answer to question 10 (in Figure 10-1) is *no*, then the determination is *not likely to adversely affect* (NLTAA) for the indirect effects part of the BA. If the direct effects of the project are also NLTAA, then proceed with informal consultation.

If the answer to question 10 is *yes*, then the determination is *likely to adversely affect* (LTAA); the project requires formal consultation. This analysis must be combined with an analysis of the project's direct effects to complete the biological assessment.

If the consultation results in a *no jeopardy* opinion, the Services issue an incidental *take* statement for *take* that cannot be avoided. The Services do not have to authorize *take* for indirect effects over which FHWA has no jurisdiction. The incidental *take* statement includes reasonable and prudent measures (RPMs) to minimize *take*, together with terms and conditions. If the consultation results in a *jeopardy* opinion, reasonable and prudent alternatives may be provided to avoid jeopardy to the species or adverse modification of critical habitat. Also, the Services may make voluntary conservation recommendations to help further reduce potential effects.

As part of formal consultation, the effects of the action must be evaluated in the context of cumulative effects. These are defined in the ESA as the effects of future state, tribal, local, or private activities that are reasonably certain to occur in the foreseeable future within the action area. The larger the extent of the project action area, the more extensive this aspect of the consultation becomes. Once identified, the cumulative effects are evaluated with the direct and indirect effects of the action, to provide the context for the Services' jeopardy/adverse modification determination. Project impacts in areas where baseline conditions are severely degraded are more significant than those where the baseline is functioning well.

> *Example:* Indirect impacts of growth induced by the proposed SR 1 interchange and road extension project *may affect but are not likely to adversely affect* bald eagles.

A *may affect* determination is based on:

- The possibility of disturbance and habitat impacts resulting from induced development at the proposed interchange located within 0.25 miles of a bald eagle nest
- The potential for water quality impacts that could affect bald eagle food resources.

A *not likely to adversely affect* determination is based on:

- The applicability of state and federal laws regulating development activities in the vicinity of bald eagle nests located in the action area

- The applicability of the local agency's critical area ordinance and stormwater treatment requirements minimizing impacts on bald eagle habitat and food resources.

Note that these preliminary effect determinations represent the indirect effects only and must be combined with analysis of the direct effects to reach an overall effect determination for each listed species and critical habitat.

10.3 Example of an Indirect Effects Section

An example of an Indirect Effects section of a BA is provided below.

Indirect Effects

Land Use and Development: The project is intended to address current and anticipated traffic conditions. Although it will accommodate increased volumes of traffic, the project does not provide new access to areas in the vicinity. Significant changes to highway capacity have the potential to influence land development, but effects directly attributable to modifying the capacity of existing systems are unclear. Many projects are intended to improve traffic flow, relieve congestion, and/or increase safety. These generally constitute actions that are not likely to cause indirect effects such as land use change. This project may increase capacity along this portion of the I-5 corridor by adding HOV lanes to the north and southbound lanes of the roadway however, it is difficult to recognize and very difficult to quantify whether it actually increases capacity or simply routes the same traffic in different ways.

The relationship between transportation and land use is also difficult to determine. Growth in Pierce County will largely be determined by a broad set of factors that include:

- Economic or market forces — housing costs, the availability of land, interest rates, overall regional economy, as well as national and international economic conditions
- Availability of utilities, community infrastructure, and public services, including water, sewer, roads, schools, parks, etc.
- Local jurisdiction land use plans and policies as administered through zoning codes and other land use regulations.

While major investments in transportation and other infrastructure are typically planned to support the demand of current and projected population over a specific period, in recent years there have been an increasing number of studies devoted to induced growth (Caltrans 1997).

For the purposes of the I-5 HOV lane project, induced growth is defined as the relationship between the project and unplanned growth, or land use, within the project action area. WSDOT has not found a method to quantify indirect effects, such as unplanned growth or changes in land use, directly attributable to HOV lane construction in the SR 5 corridor. Nonetheless, impacts can be inferred based on informed speculation.

The principal indirect effect ascribable to transportation projects is land development. Land development may impact natural resource systems such as agricultural land, wildlife habitat, and waterways that support populations of listed species, and would likely result in increased demand for transportation services, capacity on roadways and transit services.

Transportation projects could contribute to an increase in the conversion of undeveloped land to urban uses, thereby displacing wildlife through loss of vegetation and wildlife habitat. Significant adverse impacts would occur where the habitat of sensitive species or areas of ecological significance, such as wetlands and riparian corridors, are degraded (USDOT et al. 1998).

The HOV lane project zone of influence is contiguous - the Tacoma, Fife, Federal Way, Kent, Des Moines, SeaTac, and Tukwila spheres of influence. The HOV lane project may contribute to the intensification of I-5 urban corridor expansion, but the cities involved are already committed to extending infrastructure to areas within their spheres of influence, and the HOV lane project is consistent with local land use and transportation plans and policies.

The Stage 7 project will facilitate planned growth of the region, but will not serve to augment that growth. Local comprehensive plans, development and sensitive areas regulations, have been established to manage the impacts of growth through issuance of building permits. The application for a building permit triggers a project review that is independent of ESA requirements. Land development actions must pass an environmental review and adhere to several local, county, state, and federal regulations to protect environmentally sensitive areas. Other permitting means employed to manage growth throughout the state are listed below.

- Water quality certification
- Local clearing & grading permits
- Forest practices approval
- Floodplain development
- National Historic Preservation Act; Section 106
- Hydraulic project approval
- State waste discharge permit
- Shoreline permit
- Tribal permits

- Temporary modification of water quality standards
- Water use permit—Corps of Engineers Section 404 or Section 10 permits
- Section 4(f)/6(f): Wildlife refuges, recreation areas, and historic properties
- Coastal zone management certification.

Conclusion. Growth anticipated throughout Pierce County, unrelated to the SR 5 HOV lane project, will add to traffic congestion on major arterials as well as local streets. Growth in the county will also contribute to traffic on SR 5, and since impacts on the transportation system cannot be evaluated in isolation, an analysis of impact should focus on a countywide level.

The question of growth inducement asks whether the SR 5 HOV lane project would generate even more growth than would have occurred without the project. New or induced growth would occur only if the project significantly increased the propensity for economic growth of the region. Otherwise, any observed growth associated with the HOV lane would be the result of a redistribution of growth within the action area, e.g., growth that would have occurred somewhere in the region whether or not the HOV lane project existed. HOV lanes do not inherently support economic growth and will not result in induced growth, but will facilitate the planned growth in the action area.

In summary, the project will have no indirect effects on listed species and habitats within the project action area.

As discussed in PART 1, unsubstantiated claims are a common flaw in BAs. Below is an example of an inadequate representation and summary of indirect effects, followed by a reviewer's comments.

Indirect Effects

The widening of X and Y avenues will not change the existing use of this area. The eventual use of the area by commercial businesses will occur despite the upgrading of this road at this time…

This sort of statement is very common but does not provide an explanation of how the author came up with such a statement. Is development occurring already? Are contractors ready to build on the unimproved site without waiting for the road project? If surrounding areas are zoned for development, why aren't they being built upon now? Plans should be provided to reviewers illustrating that construction is already happening or will happen imminently. Do these plans mention anything regarding the need for transportation improvements?

An example of an indirect effects analysis that USFWS reviewers considered successful is provided below. Only the text portion of the analysis is provided here, although the analysis also included zoning maps, land use plans (historical and current), a traffic analysis, and master plan figures for the nearby municipality. Most indirect effect analyses include substantial supporting information as appendices.

> Indirect effects are those effects that are caused by or will result from the proposed action and occur later in time, but are still reasonably certain to occur [50 CFR § 402.02].
>
> Possible indirect effects of the proposed project include possible failure of stormwater treatment facilities, which could allow foreign material to enter waterways.
>
> Development of the industrial areas within the project action area may be considered by some to be an indirect effect of the interchange project. However, according to the City of Storyville (letter dated August 30, 1999), "This area has experienced, and will continue to experience, significant industrial development regardless of whether the interchange is constructed. The construction of the interchange is not intended to further facilitate construction of industrial facilities. Access to the area is already available from SR 0 to the south and from the Alder Street interchange on SR 12. The interchange will better serve the existing and future cross-town truck traffic through the city center from SR 0, which is congesting our city streets."
>
> To support this claim, the city provided a traffic study conducted for one of the developments within the industrial area, which indicates that the development (which is highly dependent on trucking) could occur and operate effectively without construction of the north Storyville interchange project, if other local road improvements are made.
>
> Therefore, any impacts on listed species or habitat that result from development within the action area are properly considered in the Cumulative Effects section below.

As noted above, indirect effects analyses can be very detailed. One of the documents referenced by USFWS as containing a particularly thorough analysis of effects was 15 pages long for the indirect effects analysis alone. This analysis addressed four interrelated projects located adjacent to each other along a single roadway. Because the projects were interrelated, USFWS requested that the indirect effects be collectively assessed for the four projects. This well-written analysis included the following:

- A discussion of the phasing for each of the staged projects
- A detailed description and map of the zone of influence or action area
- The indirect effects analysis itself
- A preliminary effect determination based on the indirect effects analysis for each species in the project action area.

The BA also provided supporting documentation, including the following:

- References for information sources

- Maps of local zoning and areas of approved development within the project action area
- Historical land development by grid section
- Past and present photographs along the proposed alignment
- Several maps illustrating lots with projects under review within the defined zone of influence.

11.0 Cumulative Effects

11.0 Cumulative Effects

Chapter Summary

- Cumulative effects are effects of future state or private activities that are reasonably certain to occur within the action area.
- Cumulative effects discussions are included only in BAs that require formal consultation, i.e., those with *likely to adversely affect* (LTAA) effect determinations for one or more listed species or designated critical habitats.
- The cumulative effects of a proposed action do not contribute to the definition of the action area.
- Effect determinations for a project are not influenced by cumulative effects.
- The action area defines the geographic scope of the cumulative effects analysis.

This chapter discusses the importance of differentiating between cumulative effects and indirect effects and provides an excerpt from a cumulative effects section of a BA that has been recommended by the Services as being well written. As defined in PART 3, GLOSSARY AND ABBREVIATIONS, cumulative effects are the effects of future state or private activities that are reasonably certain to occur within the action area. (This definition of cumulative effects is different from the one provided under NEPA.) Cumulative effects discussions are included only in BAs that require formal consultation, i.e., those with LTAA effect determinations for one or more listed species or designated critical habitats.

If development occurring in the project vicinity cannot be attributed to or linked to the project (i.e., is not demonstrably interrelated or interdependent) and this is verified by local planners or officials, the subsequent developments are not indirect effects of the proposed project and should be addressed in a cumulative effects analysis.

The cumulative effects of a proposed action do not contribute to the definition of the action area. The action area is defined by the limits of direct and indirect effects of the proposed action and also from interdependent and interrelated activities. Therefore, the effect determinations for a project are not influenced by cumulative effects, even if the cumulative effects occur within the action area. The purpose of the cumulative effects analysis is to aid the USFWS and NOAA Fisheries in making jeopardy and no jeopardy calls for a species, in preparing biological opinions, and in tracking the environmental conditions throughout a general area.

11.1 Example BA Section

The following excerpt (also provided in PART 2, INDIRECT EFFECTS) illustrates how the project biologist clearly differentiated between the indirect and cumulative effects of the proposed project.

> Indirect effects are those effects that are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur [50 CFR § 402.02].
>
> Possible indirect effects of the proposed project include increased maintenance efforts associated with the new interchange and possible failure of stormwater facilities, which could allow foreign material to enter waterways.
>
> Development of the industrial areas within the action area may be considered by some to be an indirect effect of the interchange project. However, according to the City of Storyville (letter dated August 30, 1999), "This area has experienced, and will continue to experience, significant industrial development regardless of whether the interchange is constructed. The construction of the interchange is not intended to further facilitate construction of industrial facilities. Access to the area is already available from SR 0 to the south and from the Alder Street interchange on SR 2. The interchange will better serve the existing and future cross-town truck traffic through the city center from SR 0, which is congesting our city streets." To support this claim, the city provided a traffic study conducted for one of the proposed developments within the industrial area. Study results indicated that the development (which was highly dependent on trucking) could occur and operate effectively without construction of the Rainier interchange project if other local road improvements were made.
>
> Therefore, any impacts on listed species or habitat that result from development within the action area are properly considered in the Cumulative Effects section of this BA.

An example of the cumulative effects section of the same BA is provided below. Only the text portion of the analysis is provided; the analysis also included zoning maps, land use plans (historical and current), a traffic analysis report, and master plan figures for the nearby municipality (including development status maps and relevant municipal code sections). Most well-written cumulative effects analyses include substantial supporting information as appendices.

> Cumulative effects are those effects of future state or private activities, not involving federal activities, that are reasonably certain to occur within the action area of the federal action subject to consultation [50 CFR § 402.02].
>
> It is the responsibility of the USFWS and NOAA Fisheries to review all federal actions and the cumulative effects of all state and private actions when making a jeopardy/no jeopardy call on a species and preparing their biological opinion. The conclusions of this biological assessment are based upon the direct and

indirect effects and the interrelated and interdependent activities of the project, but not the cumulative effects. The possible effects in this section are provided for the federal agencies' information only.

The development of the industrial area within the action area may be considered a cumulative effect on listed species and habitat. Much of the area within the action area has been developed in the past few years, is under construction, or is permitted for development (see development status map). To minimize potential impacts, the City of Storyville has development regulations in place that, if enforced, will reduce impacts on listed species.

These regulations include:

Control of erosion and sedimentation of waterways is addressed in Chapter 16.05 of the Storyville municipal code (SMC). A TESC permit is required for any development activity where 50 cubic yards (or more) of earth is moved or more than one acre of land is stripped or cleared. The city has adopted the King County stormwater manual. In addition to approving TESC plans and inspecting the work for containment fences, silt ponds or traps, rock entrances and final vegetation of slopes and cleared ground, the city visits each permitted site in late summer and works with the developer and/or contractor in preparing the site for the coming wet winter weather.

The city enacted a stormwater management program in September 1993. These regulations are codified in chapter 13.48 and 13.36 of the SMC. The King County stormwater manual was adopted with some additions as outlined in the appendix to SMC 13.48. All runoff from new parking lots, driveways, and streets are treated. All new developments with more than 5,000 square feet of impervious surface provide detention of the 25-year developed storm at the 2-year predevelopment discharge rate.

Under SMC 16.56, all proposed development within 1,000 feet of salmon-bearing streams will be required to submit a habitat assessment prepared by a professional wildlife biologist. In addition, the city's shoreline master program prohibits most development within 200 feet of affected waterways (including the Cottonwood River), and SMC 16.56 also requires undeveloped buffers of at least 100 feet on type 3 streams such as Red Cedar Creek.

12.0 Effect Determination Language

12.0 Effect Determination Language

Chapter Summary

- *No effect* (NE) means no effect whatsoever, including any beneficial, highly improbable, or insignificant effects that may result from the project.
- *Not likely to adversely affect* (NLTAA) is the appropriate determination if direct and indirect effects of a federal project (including any interrelated and interdependent activities) are expected to be discountable, insignificant, or completely beneficial.
- *Likely to adversely affect* (LTAA) is the appropriate determination if any adverse effect on listed species may occur as a direct or indirect result of a project (including any interrelated or interdependent actions), and these effects are not discountable, insignificant, or entirely beneficial.
- Effect determination language to use for listed species and designated critical habitat:
  - The project **will have no effect** on *[name of species or critical habitat]* because . . .
    Provide rationale for this effect determination.
  - The project **may affect** *[name of species or critical habitat]* because . . .
    Provide reasons why this species or critical habitat may be affected.
    - But the project **is not likely to adversely affect** *[name of species or critical habitat]* because . . .
      Provide rationale for this effect determination.
      (*or*)
    - And the project **is likely to adversely affect** *[name of species or critical habitat]* because . . .
      Provide rationale for this effect determination.
- Effect determination language to use for proposed species:
  - The project **will not jeopardize the continued existence** of *[name of proposed species]* because . . .
    Provide rationale for this jeopardy call.
  - However, in the event that *[name of proposed species]* becomes listed prior to completion of the project, a provisional effect

determination is provided:
The project **may affect** *[name of proposed species]* because . . .
Provide reasons why this species may be affected.

- ◻ But the project **is not likely to adversely affect** *[name of species]* because . . .
  Provide rationale for this effect determination.
  (*or*)

- ◻ And the project **is likely to adversely affect** *[name of proposed species]* because . . .
  Provide rationale for this effect determination.

- ▪ The jeopardy call language for proposed species is **will** or **will not jeopardize the continued existence** of *[name of proposed species]*.

- ▪ A jeopardy call is made at the species level, not the individual level. Jeopardy occurs when an action reduces the likelihood of both the survival and recovery of a listed species in the wild by reducing reproduction, numbers, or distribution of that species. (Impacts on individuals but not on the survival of the species as a whole do not warrant a jeopardy call.) Projects that receive a jeopardy call are not likely to be constructed.

- ▪ The provisional effect determination for proposed species can be NE, NLTAA, or LTAA, as explained above for listed species.

- ▪ Effect determination language to use for proposed critical habitat:

  - ◻ The project **will not destroy or adversely modify** proposed *[name of proposed critical habitat]* critical habitat because . . .
    Provide rationale for adverse modification call.

  - ◻ If *[name of proposed critical habitat]* is designated prior to completion of this project, a provisional effect determination for critical habitat is provided:
    The project **will have no effect** on *(name of proposed critical habitat*) because . . .
    Provide rationale for this effect determination.

  - ◻ The project **may affect** *[name of proposed critical habitat]* because . . .
    Provide reasons why critical habitat may be affected.

    - ◻ But the project **is not likely to adversely affect** *[name of proposed critical habitat]* because . . .
      Provide rationale for this effect determination.
      (*or*)

  - And the project **is likely to adversely affect** *[name of proposed critical habitat]* because . . .
    Provide rationale for this effect determination.

- The adverse modification language for proposed critical habitat is **will** or **will not destroy or adversely modify** proposed *[name of proposed critical habitat]*.

- An adverse modification call is made for a species' critical habitat as a whole. Adverse modification of critical habitat is not allowed under the ESA and occurs when the habitat characteristics or the necessary habitat elements are changed to such an extent that the habitat no longer functions as critical habitat.

- The provisional effect determination can be NE, NLTAA, or LTAA, as explained above for designated critical habitats.

All supporting information and effect determinations for candidate species and species of concern should be included in the appendices of the BA.

For candidate species, the project biologist should determine whether the project **is** or **is not likely to significantly impact** populations, individuals, or suitable habitat.

This chapter provides guidance for making effect determinations for species and habitat. Common flaws in making effect determinations are discussed, as are issues of debate. Flowcharts are provided to illustrate the effect determination process for terrestrial species, bald eagles, and critical habitat. BA writing samples are included to show examples of effectively written effect determinations.

12.1 Common Flaws in Making Effect Determinations

The preamble to the ESA Section 7 regulations states that projects found to have beneficial, insignificant, or discountable effects on listed species may be approved by the Services through the informal consultation process. Service approval is contingent upon the BA (or BE) providing an adequate justification for the effect determination. The Services cannot concur with an effect determination without adequate supporting information. Insufficient supporting material often delays the informal consultation process.

Frequently, a BA concludes with effect determinations that may not be wrong but simply are not justified with supporting evidence and rationale in the BA. The BA should lead the reviewer through a discussion of effects to a logical, well-supported conclusion.

For example, certain arguments might justify a NLTAA determination but do not support the often-chosen NE determination. A NE determination means that there will be absolutely no effect, not that a small effect will occur or that an effect is unlikely to occur. If effects are insignificant (in size) or discountable (meaning they are extremely unlikely to occur), a NLTAA determination is probably appropriate. An action that results in only beneficial effects on a particular species does not qualify for a NE determination; rather, a NLTAA determination is appropriate.

Three types of inappropriate arguments commonly used in BAs to support effect determinations are discussed below in an excerpt adapted from *Biological Assessment Preparation and Review*, proceedings of a 1993 workshop (updated in 1998) sponsored by the USFWS; Resources Northwest, Inc.; and the Washington chapter of the Wildlife Society.

> *The Displacement Approach*
>
> This relates to the argument that removal of habitat or disturbance of individuals warrants a NLTAA or NE determination because individuals can simply go elsewhere. Except for wide-ranging species such as grizzly bears, gray wolves, and bald eagles, this argument is usually unacceptable. When the argument is used, some rationale must be provided to indicate that adequate refugia are available and the impact will not occur during denning or nesting periods. In any case, a *no-effect* call in these situations is usually inappropriate. The species will be affected but, depending on the situation, perhaps not adversely so.
>
> *The Not-Known-to-Occur-Here Approach*
>
> Stating that the species is *not known to occur here* suggests that no surveys—or inadequate surveys—cover the area. Unless adequate surveys have been conducted or adequate information sources have been referenced, the “not known” statement is difficult to interpret. It raises the questions *Have you looked?* and *How have you looked?*
>
> Rather than “not known,” the operative phrase is “known not.” A determination of NE or NLTAA must pass a *known-not-to-occur-here* test. The BA must show that the species is *known not to occur here*.
>
> Always reference information sources. Have you queried the Washington Department of Fish and Wildlife's Priority Habitats and Species database, for example? Species occurrence information that is generated through one day/year surveys (i.e., the mid-winter bald eagle counts) or wildlife observation cards (which more closely reflect the location of people, for example) are usually inadequate to justify species absence. Bald eagle nest sites are surveyed yearly by the state, and this information is usually up-to-date and reliable. In situations where wide-ranging species are difficult to census (e.g., grizzly bear and gray wolf), it is advisable to assume species presence if the habitat is present.
>
> The timing of surveys is also important. Consider the life history of the species when scheduling surveys. Many plants are only identifiable while flowering, for example. Midwinter bald eagle counts conducted once a year are inadequate for locating roost or nest areas.

An example of making an inappropriate effect determination based upon the assumption that a species is "not known to occur here" is a no-effect determination for bull trout within Lake Washington. Bull trout have access to and have been historically documented in Lake Washington; however, their occurrence in the lake is so rare that it is unlikely they would be exposed to impacts associated with in-water work in the Lake Washington system. When potential impacts are considered discountable rather than impossible, as in this example, an effect determination of NLTAA, rather than NE, is appropriate.

The Leap-of-Faith Approach

The leap-of-faith approach refers to the assumption of some project biologists that the Services reviewer is familiar with the project and its location, so that there is no need to fully explain the impact the project may have on listed species. There is little or no connection or rationale provided to lead the reader from the project description to the effect determination. Reviewers cannot assume conditions that are not presented in the BA. A BA that contains such assumptions leaves both the project proponent and the Services at risk of being challenged by third parties who do not necessarily share in or trust the good working relationship between the Services and project biologists.

12.2 Determinations for Species

The process for making an effect determination is illustrated in the flowcharts presented in Figures 12-1 and 12-2. Figure 12-1 illustrates this process for terrestrial species, and Figure 12-2 illustrates the process for bald eagles.

12.2.1 Effect Determinations for Listed Species

When the process of assessing project impacts upon each species is completed, one of three effect determinations must be made: NE, NLTAA, or LTAA. The Effects Analysis section of the BA must provide sufficient information to substantiate the effect determination. Often a project biologist summarizes the impacts to support the effect determination, as illustrated in the effect determination language examples below.

12.2.1.1 No Effect Determinations for Listed Species

If a project will have no effect whatsoever (not a minimal effect or a long-term beneficial effect) on a listed species, a NE determination is appropriate. NE means no effect whatsoever, including no beneficial, highly improbable, or insignificant effects will result from the project. An example of this language is provided below for a listed species:

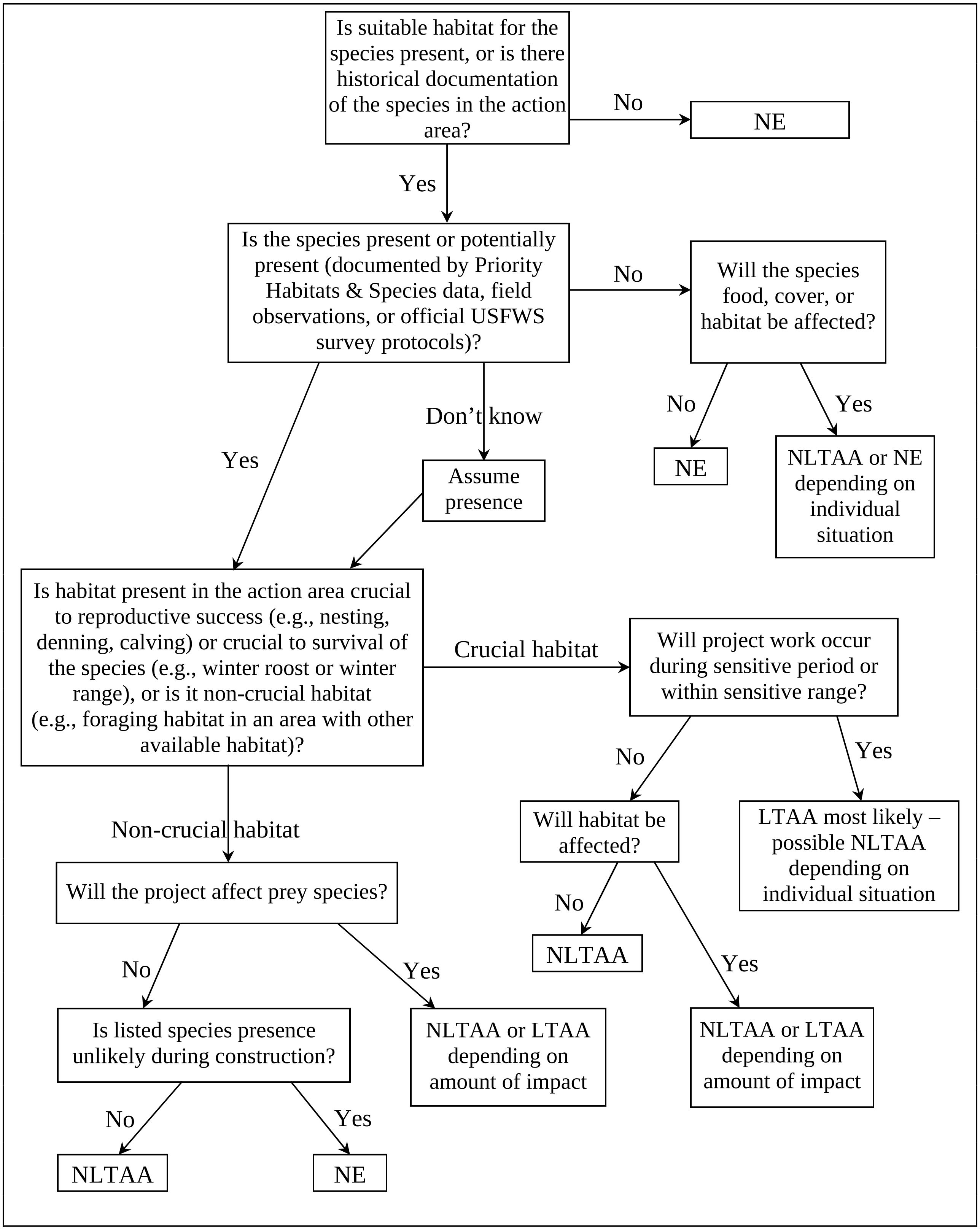

Figure 12-1. Making effect determinations for terrestrial species.

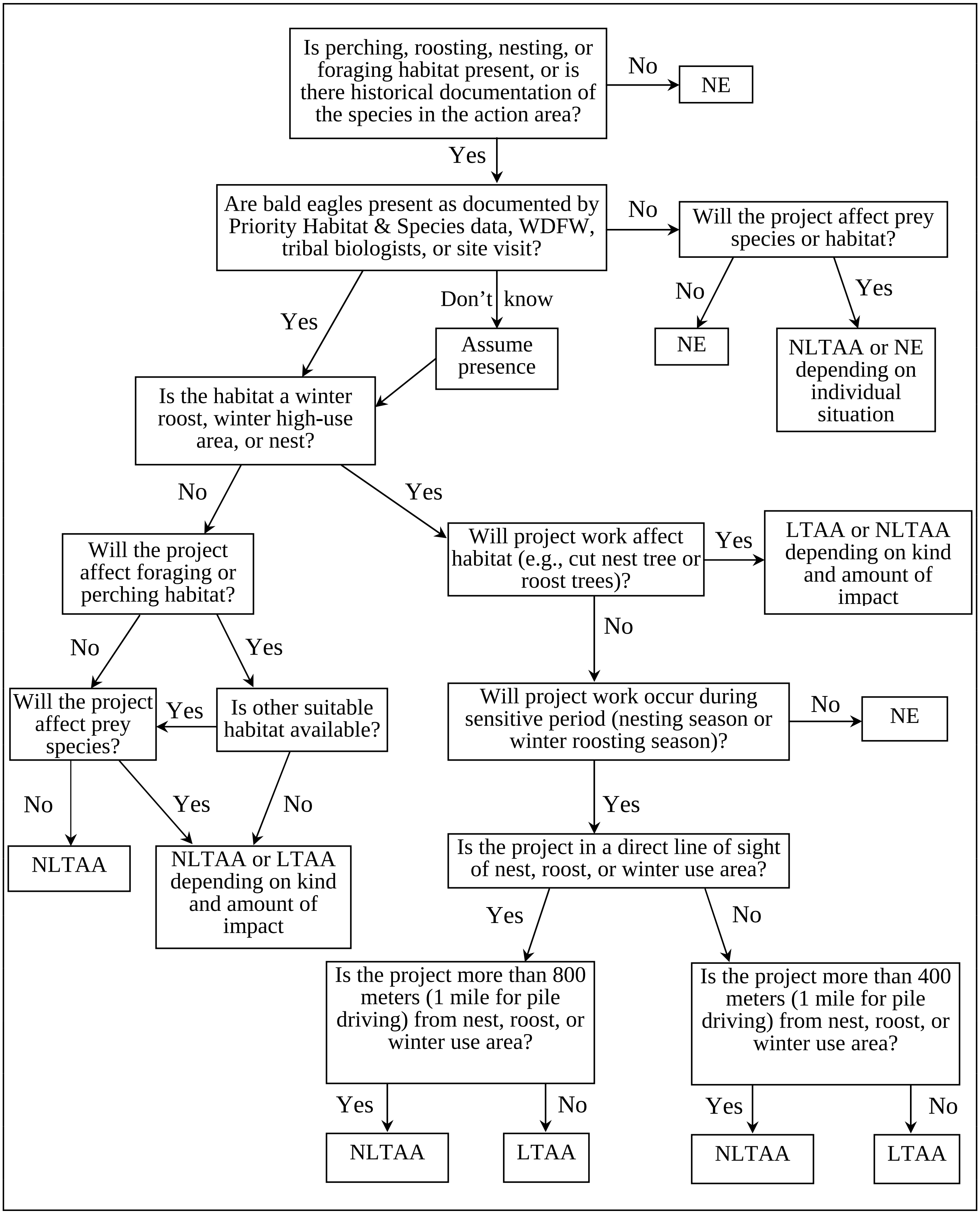

Figure 12-2. Making effect determinations for bald eagles.

Northern spotted owl: No effect.

The project will have **no effect** on northern spotted owls because:

- ◆ No suitable nesting habitat occurs in the project action area.
- ◆ The nearest breeding occurrence is more than 6 miles away.
- ◆ Habitat present in the vicinity of the project is not suitable for foraging or dispersal.

12.2.1.2 May Affect, Not Likely to Adversely Affect Determinations for Listed Species

If direct and indirect effects from a federal project (including any interrelated and interdependent activities) are expected to be discountable, insignificant, or completely beneficial, the appropriate conclusion is NLTAA for listed species. *Insignificant* indicates that the impact of an action never reaches the level where *take* occurs or where destruction or adverse modification of critical habitat occurs. *Discountable* indicates that it is extremely unlikely that impacts will occur.

A USFWS example of this NLTAA language is provided below for a listed species:

> The project may affect but is not likely to adversely affect bull trout. A *may-affect* determination is warranted because the project involves ground-disturbing activities in a water body that may support bull trout, and it is upstream of forage fish habitat. A *not likely to adversely affect* determination is warranted, because bull trout are not expected to be present during construction, and because sediment from the project is not expected to reach the forage fish spawning habitat.

Two additional examples of NLTAA language are provided below for listed species.

Example 1:

The project **may affect** marbled murrelet because:

- ◆ Suitable habitat may be available in the mature spruce forest in the westernmost portion of the action area.
- ◆ Noise disturbance from construction activities will be audible within a portion of the marbled murrelet suitable habitat.

The project is **not likely to adversely affect** the marbled murrelet because:

- ◆ A survey of the area in 1997 resulted in no marbled murrelet detections. It is unlikely that marbled murrelets will be exposed to the project activities.
- ◆ No marbled murrelet suitable habitat will be removed as a result of this project.

- The potential marbled murrelet suitable habitat (greater than 150 meters from the project site) is outside the distances associated with project activity injury thresholds (less than 75 meters for high-action-generated sounds).

Example 2:

The project **may affect** Columbian white-tailed deer because:

- Suitable deer foraging habitat is present within the action area.
- Suitable habitat will be removed within the new roadway corridor and will be altered with establishment of the proposed waste site.

The project is **not likely to adversely affect** the Columbian white-tailed deer because:

- The only known populations of Columbian white-tailed deer in Washington state are located within the Julia Butler Hansen National Wildlife Refuge, and on Puget and Crims islands within the Columbia River corridor. The nearest of these populations is located more than 12 miles east and south of the project site. It is highly unlikely that Columbian white-tailed deer will be exposed to project activities.

12.2.1.3 May Affect, Likely to Adversely Affect Determinations for Listed Species

If any adverse effect on listed species may occur as a direct or indirect result of a project (including any interrelated or interdependent actions), and these effects are not discountable, insignificant, or completely beneficial, the appropriate conclusion or effect determination for a proposed action is LTAA. If the overall effect of the proposed action is beneficial to the listed species (or its designated critical habitat) but is also likely to cause some adverse effects, even in the short term, then the project merits an LTAA determination for listed species and critical habitat.

If incidental *take* is anticipated to occur as a result of the proposed action, an LTAA determination must be made. An LTAA determination requires formal consultation with the Services. An effect determination is made at the individual level rather than the species level (i.e., the determination is based on impacts on individual members of the species, even when survival of the species as a whole is not affected). An example of language for a project that will adversely affect listed species is provided below:

The project **may affect** Puget Sound chinook salmon because:

- Suitable chinook rearing habitat is present within the action area.
- Suitable rearing habitat will be destroyed as a result of the project.
- Water quality will be temporarily degraded as a result of in-water work.

The project is **likely to adversely affect** Puget Sound chinook salmon because:

- Chinook salmon are known to rear in the immediate vicinity of the bridge site during the time of year when project activities will occur.
- Construction of the bridge will require placement of four large (6-foot-diameter) concrete piles in the canal.
- The old bridge may or may not be removed. If it is removed, the removal will have a long-term beneficial effect on water quality, but will have short-term adverse impacts on water quality due to suspension of sediments and potential resuspension of creosote.

12.2.2 Effect Determinations for Proposed Species

For proposed species that are addressed in the BA, the project biologist should provide a summary of the Analysis of Effects section. The BA should then provide the appropriate jeopardy determination for proposed species by concluding that the project is *likely to jeopardize the continued existence of the (name of species),* or that the project *is not likely to jeopardize the continued existence of the (name of species).* A jeopardy call is made at the species level, not the individual level.

> *Jeopardy – to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing reproduction, numbers, or distribution of that species. [50 CFR 402.02]*

The BA should also provide a conditional or provisional effect determination (NE, NLTAA, or LTAA) in the event that the species becomes listed prior to project completion. The rationale upon which this determination is made should be justified with a summary of relevant supporting evidence (e.g., specific information from field surveys agency coordination).

A project may be granted an incidental *take* permit for individuals, but not for a species as a whole, unless approved by the Endangered Species Committee. The role of the Endangered Species Committee and its process is discussed in detail in the DETERMINATIONS FOR CRITICAL HABITAT section below. A statement acknowledging the impact of the proposed action upon individuals also may be included.

An example of the language that may be used in the jeopardy determination is provided below:

The project **will not jeopardize the continued existence** of Lower Columbia River coho because:

- Impacts on migrating spawning adults will not be sufficient to preclude both the survival and recovery of the ESU as a whole.
- Baseline conditions of the river will be maintained.

- However, if Lower Columbia River coho becomes listed prior to completion of the project, a provisional effect determination is provided below.

The project **may affect** Lower Columbia River coho because:

- Suitable migration, spawning, and rearing habitat is present within the action area.
- In-water work will occur within Grays River.

The project **is likely to adversely affect** Lower Columbia River coho because:

- Spawning adult coho migrating through the action area during project construction are likely to be disturbed by project activities.

12.2.3 Effect Determinations for Candidate Species and Species of Concern

For species addressed in the BA that are not afforded protection under the ESA (e.g., candidate species, species of concern, and state-listed species), the assessment should be included in the appendix of the BA. The project biologist should conclude whether the project *is likely to significantly impact populations, individuals, or suitable habitat*. Impacts on occupied and unoccupied suitable habitat also should be addressed. A good example of language that may be used to discuss impacts on candidate species and species of concern is provided below:

> Impacts on individuals of the lamprey species of concern (Pacific lamprey and river lamprey), the long-legged myotis, olive-sided flycatcher, tailed frog, Van Dyke's salamander, western toad, and tall bugbane are expected to result from disturbance of potentially suitable habitat, although significant impacts on populations are not expected.
>
> Because there is no habitat within the project action area for the following species of concern, the project will not result in impacts on these species: Gorge daisy, Larch Mountain salamander, long-eared myotis, Oregon sullivantia, Pacific Townsend's big-eared bat, and pale blue-eyed grass.

12.3 Determinations for Critical Habitat

A statement summarizing anticipated impacts related to project actions must also be made for designated and proposed critical habitat in the project action area. Designated and proposed critical habitat must be addressed in the BA in order to meet ESA requirements.

The process by which a project biologist should make an effect determination for critical habitat is illustrated in Figure 12-3.

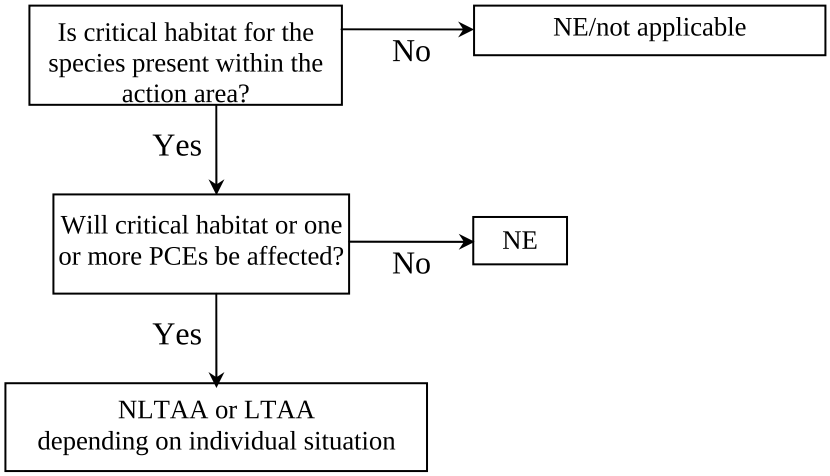

Figure 12-3. Making effect determinations for critical habitat.

The effect determination for critical habitat is one of the three standard determination categories: NE, NLTAA, or LTAA. The NLTAA determination can refer to either of two quite different scenarios: insignificant adverse effects, or anticipated beneficial effects. This difference should be specified in the Effect Determination section. Projects meriting a LTAA determination for critical habitat require formal consultation.

For species such as salmon, steelhead, bull trout, and Canada lynx, the rationale upon which the critical habitat effect determination is made should reference the primary constituent elements that may be affected and why they may or may not be adversely affected, and should justify the effect determination with a summary of relevant supporting evidence (e.g., information from field surveys and agency coordination). For example, if the critical habitat present contains six PCEs and only three PCEs may be affected by the project, then the effects of the action on each of the three PCEs should be clearly stated in the rationale. For a no effect determination, none of the PCEs would be impacted by the project. Projects affecting one or more PCEs will fall in a NLTAA or LTAA category for critical habitat. Projects with LTAA impacts to at least one PCE will result in a LTAA determination for critical habitat. An example letter providing NMFS critical habitat analysis/concurrence for a NLTAA Corps of Engineers project is provided on the Reference CD accompanying this manual. For other species such as northern spotted owl and marbled murrelet, an effect to critical habitat can result even if none of the primary constituent elements are affected. In the example in Section 12.3.1.2, the habitat is being altered, however, the alteration will not impact the primary constituent elements of northern spotted owl critical habitat; the physical and biological features that support nesting, roosting, foraging, and dispersal habitat.

Based on the effect determination and the information provided in the BA, the Services must determine if the project action will destroy or adversely modify designated critical habitat. Adverse modification to critical habitat occurs when the habitat characteristics or the necessary habitat elements are changed to such an extent that the habitat no longer functions as critical habitat.

A LTAA effect determination by a project biologist for critical habitat within the project action area may or may not merit an adverse modification call by the Services. The formal responsibility for making an adverse modification call on designated critical habitat rests with the Services. NMFS has developed guidance regarding the application of the “destruction or adverse modification” standard under section 7(a)(2) of the ESA. This guidance letter, outlines the process NMFS biologists are to follow in making an adverse modification call to critical habitat. To facilitate the Services assessment, or as a courtesy to the Services, the action agency may choose to provide a provisional adverse modification call in its BA accompanying the effect determination.

> *Destruction or Adverse Modification – A direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. Such alterations include, but are not limited to, alterations adversely modifying any of those physical or biological features that were the basis for determining the habitat to be critical. [50 CFR 402.02]*

A project determined by a Service biologist to adversely modify designated critical habitat, which is the equivalent of a jeopardy call for a listed species, cannot be conducted without modifications in accordance with a reasonable and prudent alternative (RPA) or permission from the Endangered Species Committee. As outlined in Section 7 of the ESA, an exemption to the statute can be granted only by applying to the Endangered Species Committee. This committee, composed of seven government officials including the secretary of the interior, is authorized to overrule the actions or decisions of the Services in order to grant relief from actions taken under the ESA. The committee has authority to decide that the public interest favors an action that has an adverse impact on a species (in its entirety) or results in the complete extirpation of a species.

The Endangered Species Committee is discussed below in the LTAA example provided for proposed critical habitat, as well as in the text of the ESA, which is provided on the reference compact disc accompanying this document.

12.3.1 Effect Determinations for Designated Critical Habitat

The project biologist must make an effect determination for each designated critical habitat occurring in the project action area. As indicated above, this determination consists of one of the three standard effect determinations: NE, NLTAA, or LTAA.

12.3.1.1 No-Effect Determinations for Designated Critical Habitat

An example of language for *no effect* on designated critical habitat is provided below:

> A **no-effect** determination is warranted for Snake River sockeye salmon designated critical habitat. Although the following PCEs for critical habitat are present in the project action area: spawning, rearing, and migration, they will not be impacted by project activities.

- Proposed project activities will not add any additional impervious surface area.
- Although the project crosses a stream that flows to the Snake River, no in-water work will occur.
- Although construction vehicles may use existing pull-outs for parking during hours of construction and for temporary staging areas, all of these sites are more than 500 feet from the tributary stream, and no activity will extend beyond the developed portion of the roadway (zone 2).
- No clearing, grubbing, or ground-disturbing activity is included as part of the proposed action.

12.3.1.2 Not Likely To Adversely Affect Determinations for Designated Critical Habitat

The text below provides an example of language that may be used for a NLTAA project that occurred within one designated critical habitat area but was also located a great distance from a second designated critical habitat area:

> A **may effect** determination is warranted for spotted owl critical habitat because:
>
> - The project occurs within designated spotted owl critical habitat in the Gifford Pinchot National Forest.
> - The project will result in habitat impacts within this designated critical habitat area because it requires the removal of 20 small trees (all of which are 6 to 10 inches in diameter at breast height).
>
> A **not likely to adversely affect** determination is warranted for spotted owl critical habitat because:
>
> - All trees that will be removed are directly adjacent to the highway, and removal will not appreciably diminish the value of the critical habitat.
> - No suitable nesting trees will be removed.
> - No primary constituent elements will be affected by the proposed project.

A second example of NLTAA language for critical habitat is provided below and includes an example of the supporting evidence that might be used:

> Considering the information referenced in this report and project information provided in the construction plans, this project merits an effect determination of **may affect and is likely to adversely affect** for Snake River fall-run ESU and Snake River spring/summer-run ESU Chinook salmon. This determination is warranted because the project will affect three of six primary constituent elements (PCEs). There are no barriers to Chinook and sockeye usage of Eagle Creek, and juvenile life forms of individual fish could be present during the proposed construction. In addition, the proposed action is expected to result in

the loss of a small area of potential spawning habitat, although this loss is discountable in relation to the range of these ESUs.

The project **may affect** critical habitat for Snake River fall-run ESU and Snake River spring/summer-run ESU Chinook salmon because:

- Spawning, rearing and migration PCEs are present in the action area.
- Stream barb construction will occur below the OHWM of Eagle Creek.
- Barb construction will alter channel hydrology and will displace approximately 150 square feet of native substrate that constitutes suitable spawning habitat.

The project is **not likely to adversely affect** critical habitat because:

- The loss of 150 square feet of potential spawning habitat is discountable on a reach basis or in relation to the range of these ESUs.
- The cessation of bank erosion and, as a result, the maintenance of baseline indicators for sediment and turbidity will have beneficial effects on both the watershed and the project area.
- Stabilization of stream banks, creation of in-water microhabitat, and gravel recruitment through the incorporation of large woody debris will have beneficial effects on the environmental baseline.
- Creation of low-energy refugia for salmonids during high flows and habitable scour pools during low flows will have beneficial effects on Chinook habitat. Project activities will not block migration of Chinook salmon.

During formal consultation, if the Services determine that a project will adversely modify the designated critical habitat, the project warrants an adverse modification call from the Services. The project then cannot proceed without approval from the Endangered Species Committee. The project proponent must then submit to the secretaries of Interior and Commerce a petition to overrule standard ESA practices (or to overrule a decision made under the ESA by the Services that prevents project implementation). Upon receipt of the petition, these agencies are required to notify the governors of the affected states that the governors may recommend individuals to be appointed to the Endangered Species Committee. The Interior and Commerce secretaries also must publish receipt of the petition in the Federal Register.

Under the law, during the 20-day period following receipt of the petition, the secretaries must determine whether the project proponent has carried out in good faith its responsibilities under the ESA with a “reasonable and responsible effort to develop and fairly consider modifications or reasonable and prudent alternatives.” The secretaries also must determine whether the parties submitting the petition have met all legal requirements. Following these initial determinations, a public hearing must be held and a summary report must be submitted within 140 days. The full Endangered Species Committee must decide within 30 days whether to grant an ESA exemption.

12.3.2 Effect Determinations for Proposed Critical Habitat

For proposed critical habitat, the project biologist must conclude whether the proposed project actions would *adversely modify* this habitat. The project biologist must use the proper language when presenting this conclusion by specifically stating whether the action will or will not *destroy or adversely modify* designated critical habitat. The project biologist should substantiate this claim with a summary of relevant findings or documentation.

In addition, the project biologist should provide a conditional or provisional effect determination (NE, NLTAA, or LTAA), in the event that critical habitat is designated prior to initiation or completion of the project.

12.3.2.1 Will Not Destroy or Adversely Modify/Not Likely to Adversely Affect Determination for Proposed Critical Habitat

An example is provided below of *will not destroy or adversely modify* language for proposed critical habitat, followed by a provisional *may affect, not likely to adversely affect* determination.

> The project will not destroy or adversely modify proposed bull trout habitat because:
>
> - The action area is located approximately 1.5 miles upstream of Grays Bay where proposed critical habitat occurs.
> - It is highly unlikely that the project will have a detectable effect on water quality, water quantity, stream channel complexity, substrate quality, or other primary constituent elements within proposed bull trout critical habitat, due to the distance between the action area and Grays Bay.
>
> If bull trout habitat is designated prior to completion of this project, a provisional effect determination for critical habitat is the following: The project **may affect but is not likely to adversely affect** bull trout critical habitat.
>
> A **may affect** determination is warranted for bull trout critical habitat because:
>
> - The project includes in-water work upstream of bull trout critical habitat.
>
> A **not likely to adversely affect** determination is warranted for bull trout critical habitat because:
>
> - The project will result in minor water quality impacts within the action area. However, the project action area lies 1.5 miles upstream of bull trout critical habitat.
> - The project will not result in measurable impacts on primary constituent elements within bull trout critical habitat.

12.3.2.2 Will Not Adversely Modify/Likely to Adversely Affect Determination for Proposed Critical Habitat

An example of adverse modification language, a *likely to adversely affect* determination, and supporting evidence for proposed critical habitat are provided below.

> A WSDOT project on SR 97 proposes to repair a scour hole at the base of a bridge on Peshastin Creek. The project will place rock in the streambed, temporarily disturbing 300 square feet of streambed and permanently altering 220 square feet of streambed with rock. The rock will fill two pools and create one pool, resulting in a slight loss of pool habitat. The project area provides spawning, rearing, and migration habitat for Upper Columbia River (UCR) spring chinook and UCR steelhead. The project was determined by WSDOT to likely adversely affect both species. Both species now have critical habitat proposed.
>
> Direct effects related to the project include physical disturbance or modification of the proposed critical habitat. Indirect effects include a temporary change in habitat for benthic organisms. The project will affect three of six primary constituent elements (PCEs) of bull trout critical habitat: freshwater spawning habitat, freshwater rearing habitat, and migration corridors. The anticipated impacts on the three PCEs are listed below:
>
> - Spawning: Spring chinook spawning grounds are present in the action area. Degradation by sedimentation could fill in the spawning gravel.
> - Rearing: Two pool habitats will be lost for rearing juveniles due to filling with rock. The streambed could be degraded by sediment farther downstream, resulting in a decrease in habitat complexity used by benthic invertebrate forage species.
> - Migration: The hydrology of the area will be altered, potentially affecting migration through the bridge area.
>
> The project **will not destroy or adversely modify** proposed UCR spring chinook and UCR steelhead proposed critical habitat because:
>
> - Change in pool habitat was not found to be measurable or significant on a reach basis.
> - Despite impacts to three of six PCEs, changes will not appreciably diminish the value of the critical habitat.
>
> If proposed UCR spring chinook and UCR steelhead critical habitat is designated prior to completion of this project, a provisional effect determination for critical habitat is the following: The project **may affect and is likely to adversely affect** UCR spring chinook and UCR steelhead critical habitat.
>
> The project **may affect** UCR spring chinook and UCR steelhead critical habitat because:

- The action area provides spawning, rearing, and migration habitat for UCR spring chinook and UCR steelhead.
- The project involves in-water work.

The project is **likely to adversely affect** UCR spring chinook and UCR steelhead critical habitat because:

- 200 square feet of streambed will be permanently altered with rock.
- 300 square feet of streambed will be temporarily disturbed.
- Three of six PCEs will be affected by the proposed action:
  - Spawning habitat could be degraded by sedimentation
  - Rearing habitat in the project area will be lost, and rearing habitat downstream of the project area could be degraded as a result of sedimentation
  - Changes in hydrology could affect migration.

During a formal conference, if the Services determine that a project will adversely modify the designated critical habitat, the project warrants an adverse modification call by the Services. The project then cannot proceed without approval of the Endangered Species Committee. This process is described above in the section titled EFFECT DETERMINATIONS FOR DESIGNATED CRITICAL HABITAT.

13.0 Effect Determination Guidance

13.0 Effect Determination Guidance

This chapter provides guidance for making overall effect determinations based on the effect determinations and rationale provided in the following three documents:

- *Programmatic Biological Assessment for the Washington State Department of Transportation Eastern Washington Regions – Working Document* (WSDOT 2004b)
- *No Effect and Not Likely to Adversely Affect Programmatic Biological Assessment Working Document for NOAA Fisheries Listed Species* (WSDOT 2002)
- *Biological Opinion and Letter of Concurrence of Effects on Bald Eagles, Marbled Murrelets, Northern Spotted Owls, Bull Trout, and Designated Critical Habitat for Marbled Murrelets and Northern Spotted Owls from Olympic National Forest Program Activities for August 5, 2003 to December 31, 2008* (USFWS 2003, Reference number 1-3-03-F-0833).

All three of the above-mentioned documents are programmatic BAs or relate to programmatic BAs that are used by their respective agencies (WSDOT and Olympic National Forest.) However, the effect determinations included in these documents can be used as guidance for making effect determinations in similar situations. Remember that effect determinations in programmatic BAs tend to be more conservative (i.e., more restrictive or protective) than effect determinations made on a project-by-project basis. Thus, for a given project it may be possible to reach a less conservative effect determination than the one given in the programmatic document, depending on the situation.

The first section of this chapter provides guidance for integrating multiple effect determinations for specific project elements into a single overall effect determination for each species addressed in the BA.

The second section of this chapter provides guidance for making effect determinations for species and critical habitats based on general standards and disturbance thresholds. This guidance is based on the definitions and criteria for *no effect* (NE), *not likely to adversely affect* (NLTAA), and *likely to adversely affect* (LTAA) determinations and the disturbance thresholds for species and critical habitat presented in the three documents listed above. The disturbance thresholds are based upon recent research regarding noise and visual disturbance. These thresholds can also serve as standards for making effect determinations.

13.1 Making Overall Effect Determinations

The biological assessment must provide a single effect determination, reflecting the impacts of the project as a whole, for each species and critical habitat. To do so, the project biologist must systematically consider all of the potential effects associated with various project elements in combination. To facilitate the effects analysis, each of these project elements may first be evaluated individually, and effect determinations for each element may be developed. However, all of these elements and their associated effect determinations must subsequently be considered in combination to develop an overall effect determination for the project for each species or critical habitat.

One technique that can facilitate this process of determining overall project impacts is developing a worksheet that lists all affected species and all project elements, and the effect determinations associated with each. Although the worksheet should not be included in the BA, it can be a useful tool for ensuring that all anticipated project impacts are considered when making the overall effect determination for each species and critical habitat. An example of this type of worksheet is presented in Table 13-1.

Table 13-1. Worksheet for determining overall effect determination for each affected species and critical habitat.

Regulatory Jurisdiction	Federal Status [a]	Common Name	Effect Determination for Stormwater Runoff	Effect Determination for In-Water Work	Effect Determination for Pile Driving	Effect Determination for Clearing and Grading	Overall Effect Determination for Project
USFWS	E	Gray wolf	NE	NE	NLTAA	NE	NLTAA
	E	Marsh sandwort	NE	NE	NLTAA	NLTAA	NLTAA
	T	Canada lynx	NE	NE	NLTAA	NE	NLTAA
	T	Grizzly bear	NE	NE	NLTAA	NE	NLTAA
	T	Bald eagle	NE	NLTAA	LTAA	NLTAA	LTAA
	T	Marbled murrelet	NE	NE	LTAA	NLTAA	LTAA
	T	Northern spotted owl	NE	NE	LTAA	NLTAA	LTAA
	T	Coastal/Puget Sound bull trout (DPS)	NLTAA	LTAA	NLTAA	NLTAA	LTAA
	T	Water howellia	NLTAA	NE	NE	NE	NLTAA
	T	Golden paintbrush	NE	NLTAA	NLTAA	NLTAA	NLTAA
NOAA Fisheries	E	Humpback whale	NE	NE	NE	NE	NE
	E	Leatherback sea turtle	NE	NE	NE	NE	NE
	T	Steller sea lion	NE	NE	NE	NE	NE
	T	Puget Sound chinook salmon (ESU)	NLTAA	LTAA	NLTAA	NLTAA	LTAA
	T	Hood Canal summer chum salmon (ESU)	NLTAA	LTAA	NLTAA	NLTAA	LTAA
	P	Southern resident killer whale (DPS)	NLTAA	NLTAA	NLTAA	NLTAA	LTAA

T = threatened; E = endangered; NE = no effect; LTAA = likely to adversely affect; NLTAA = not likely to adversely affect; DPS = distinct population segment; ESU = evolutionarily significant unit.

13.2 Effect Determinations for Species

13.2.1 Effect Determinations for Listed Species

The following sections provide effect determination guidance for listed fish species under NOAA Fisheries and USFWS jurisdiction, followed by guidance tailored to fish, bird, small mammal, and plant species under USFWS jurisdiction.

13.2.1.1 Fish Species

NOAA Fisheries Listed Fish Species

For all of the fish species listed by NOAA Fisheries, effect determinations are compiled below, based on the nine program descriptions covered in the programmatic BA. Conditions for NE and NLTAA effect determinations are dependent upon the presence of listed fish species, proximity of activity to surface waters, level of disturbance, ability to contain activity within previously developed areas, use of appropriate BMPs, extent of riparian vegetation removal, work during appropriate work windows, and compliance with established guidelines, agreements, and permits. Although effect determinations are project-specific, the following conditions can serve as guidance in making effect determinations for other projects.

Many project types may warrant a determination of *no effect* on listed fish species. Examples of such projects include the following:

- Projects occurring in watersheds or water resource inventory areas (WRIAs) with no listed fish species
- Projects or maintenance activities that 1) are conducted entirely within the developed transportation system right-of-way, 2) do not remove or modify vegetation in any way, 3) do not alter existing hydrology through modified discharges, and 4) do not discharge materials (such as water, asphalt grindings, or fill material) from the developed portion of the roadway
- Bridges undergoing seismic retrofit, bridge deck repair, or overlay and replacement, provided that they include no in-water work and create no additional impervious surface area.
- Projects where there are no listed species-bearing waters within the action area.

Many project types may warrant a determination of *may affect but is not likely to adversely affect* listed fish species. Examples of such projects include the following:

- Projects that are located within 300 feet of an existing listed fish-bearing water's ordinary high water mark (OHWM) and that do not remove or alter riparian habitat.

- Projects for which best management practices (BMPs) are implemented to prevent sediments or runoff from entering surface water, and that do not permanently remove riparian vegetation greater than 6 inches in diameter at breast height (dbh) from a riparian area of a stream or river system containing listed salmonids.

- Projects in which slide material that has entered a listed fish-bearing water body will be removed within the appropriate work window when listed fish species are not likely to be present in the action area.

- Projects that require work below the OHWM to replace or extend culverts, provided that no ESA-listed salmonid species are present in the system during the approved work window, and that the work does not disturb spawning habitat. (Road crossing replacement culverts are to be designed in accordance with *Fish Passage Design at Road Culverts: A Design Manual for Fish Passage at Road Crossings* [WDFW 1999]. Tide gate replacement should use guidance in the *Programmatic Biological Opinion: Phase II Fish Passage Restoration, Department of Army Permits* [November 19, 2001]).

- Projects that relocate streams farther from the roadway or separate ditch or stream systems, provided that 1) listed salmonid species are not present in the system during construction, and 2) the activity restores or improves habitat functions that were provided by the original channel, through creation of meanders or vegetated stream banks, or installation of habitat structures.

- Projects that replace existing riprap structures with no expansion of the original footprint, based on the as-built plans, or projects that remove an equivalent amount of riprap within the project area during a period when listed fish species are not likely to be present.

USFWS Listed Fish Species

Bull trout is currently the only fish species listed by USFWS and covered in the WSDOT programmatic BA for eastern Washington. Conditions for NE, NLTAA, and LTAA effect determinations for bull trout depend upon bull trout presence, proximity of project activity to surface waters, bull trout use of the water body (spawning, rearing, or migration), level of disturbance, ability to contain activity within previously developed areas, use of appropriate BMPs, extent of riparian vegetation removal, and work within appropriate work windows. Projects located in bull trout spawning watersheds, which are very small headwater systems, are likely to have greater adverse effects and require more conservative effect determinations than projects located in watersheds used only for migration.

Examples of projects that may warrant a determination of *no effect* on bull trout include the following:

- Projects located in WRIAs that do not contain bull trout
- Projects that 1) are conducted entirely within the developed portion of the roadway, 2) do not remove or modify vegetation in any way, 3) do not alter existing hydrology through modified discharges, and 4) do not discharge materials (such as water or asphalt grinds) from the developed portion of the roadway.

Examples of projects that may warrant a determination of *may affect but is not likely to adversely affect* bull trout include the following:

- Activities located within 300 feet of a water body that supports bull trout or drains into a bull-trout-supporting water body and that 1) conduct work off the developed portion of the roadway, 2) do not expose soils, 3) do not create more than 150 square feet of impervious surface area, and 4) do not remove mature riparian vegetation. (This distance can be project-specific depending on factors such as topography, vegetation, habitat, or species use.)
- Activities located more than 300 feet from a water body that supports or drains into a bull-trout-supporting water body and that 1) are conducted within 100 feet of the existing transportation system, and 2) have BMPs implemented to prevent sediments or runoff from entering surface waters.
- Vegetation or ground-disturbing activities located within 100 to 300 feet of a water body that supports or drains into a bull-trout-supporting water body and that 1) are conducted within 100 feet of an existing transportation system, 2) remove no riparian vegetation greater than 6 inches dbh, and 3) implement a temporary erosion and sedimentation control (TESC) plan that is adequate to prevent sediment from entering surface water. (These distances can be project-specific depending on such factors as topography, vegetation, habitat, and species use.)
- Culvert and bridge widening, extension, repair, and replacement activities that 1) occur in waters where bull trout are unlikely to be present, 2) do not eliminate spawning habitat, 3) avoid constricting the system, 4) place less than 100 cubic yards of riprap, 5) are performed within the appropriate work window for bull trout as agreed upon by USFWS and WDFW, 6) remove less than 300 square feet of riparian vegetation, 7) use appropriate BMPs to control sedimentation, 8) revegetate disturbed vegetation, and 9) do not affect bull trout migration.

Examples of projects that may warrant a determination of *may adversely affect* bull trout include the following:

- Environmental enhancement projects, such as correction of fish barriers, installation of culverts to improve fish passage, and installation of fish habitat enhancement projects.
- In-water work activities in water bodies where listed fishes are present, especially if dewatering or fish-moving activities are likely to occur.
- Bridge and culvert widening, extension, repair, and replacement activities that do not meet the conditions of a NLTAA determination.

13.2.1.2 Bald Eagle

On February 16, 2006, the U.S. Fish and Wildlife Service also reopened the public comment period on its original 1999 proposal to remove the bald eagle from the Federal list of threatened and endangered species. In addition, USFWS released the Draft National Bald Eagle Management Guidelines. These guidelines provide additional information for assessing impacts to the species and are available on reference CD accompanying this manual and on the agency website at: <http://www.fws.gov/migratorybirds/BaldEagle.htm>.

Bald eagles are sensitive to disturbance during nesting, roosting, and wintering activities. Effect determinations are highly dependent upon the proximity of the activity to eagles, activity noise levels, visual disturbance levels, extent to which suitable habitat is removed, and timing of the activity in relation to the eagle wintering season.

Many project types may warrant a determination of *no effect* on bald eagles. Examples of such projects include the following:

- Construction activities conducted 1) at a distance greater than 0.25 miles from bald eagle use areas if not in view of nest, roost, wintering concentration, or foraging habitat within an occupied nesting or wintering territory, 2) at a distance greater than 0.5 miles if within view of nest, roost, wintering concentration, or foraging habitat within an occupied nesting or wintering territory, and 3) at a distance greater than 1 mile from a nest, roost, wintering concentration, or foraging habitat within an occupied nesting or wintering territory, if blasting or pile driving is to occur, and no trees suitable for bald eagle perching are removed.
- Activities that do not alter suitable habitat (i.e., perching, nesting, roosting, or foraging) and are conducted outside the breeding season (January 1 to August 15) and the wintering season (October 31 to March 31).
- Blasting activities between August 16 and October 31 occurring 1 mile or more from bald eagle use areas (site-, equipment-, and method-specific information can be used to shorten or lengthen the 1-mile distance for these activities).

- Impact pile driving activities between August 16 and October 31 occurring 1 mile or more from bald eagle use areas.
- Jackhammer or rock drill use between August 16 and October 31 occurring more than 0.25 miles from bald eagle use areas if not in line of sight.
- Jackhammer or rock drill use between August 16 and October 31 occurring more than 0.5 miles from bald eagle use areas if within line of sight.
- Use of large helicopter or aircraft between August 16 and October 31 at a distance of 1 mile or more from bald eagle use areas.
- Use of heavy equipment and motorized tools between August 16 and October 31 more than 0.25 miles from bald eagle use areas if not in line of sight.
- Use of heavy equipment and motorized tools between August 16 and October 31 more than 0.5 miles from bald eagle use areas if within line of sight.
- Prescribed burning activities between August 16 and October 31 occurring 1 mile or more from bald eagle use areas.

Many project types may warrant a determination of *may affect but is not likely to adversely affect* bald eagles. Examples of such projects include the following:

- Activities (except blasting and pile driving) conducted more than 0.25 miles from bald eagle use areas if not in view of a nest, wintering concentration, or communal roost, and more than 0.5 miles if within view of a nest, wintering concentration, or communal roost. Trees suitable for bald eagle perching may be removed, provided that additional suitable perch trees are present within the project area and are not disturbed.
- Activities conducted outside the nesting season that result in minor modifications of perching habitat (up to 10 trees) located more than 660 feet from a nest, provided that the trees are located within 100 feet of an existing developed transportation corridor. Modifications to the number of trees could be greater or lesser depending on baseline conditions.
- Activities conducted outside the wintering season (October 31 to March 31) that result in minor modifications of perching habitat (up to three trees) located within 330 feet of foraging habitat, provided that the trees are located within 100 feet of an existing developed transportation

corridor, and additional suitable perch trees are present within the project area and are not disturbed.

- Activities conducted outside the wintering season (October 31 to March 31) that remove potential perch trees located more than 330 feet from foraging habitat, provided that the trees are located within 100 feet of an existing developed transportation corridor.

- Activities conducted in or near suitable bald eagle nesting areas, wintering concentration areas, winter roosts, or high-use foraging areas that result in minor vegetation impacts (e.g., disturbance of trees smaller than 6 inches dbh, shrubs, and herbaceous vegetation), when eagles are not likely to be present (e.g., nesting territories outside the nesting season, wintering areas during nonwintering periods, salmonid-bearing streams when spawning salmon are not present, or wintering waterfowl concentration areas during nonwintering periods).

- Blasting activities between January 1 and August 15 or between October 31 and March 31 occurring 1 mile or more from bald eagle use areas.

- Impact pile driving activities between January 1 and August 15 or between October 31 and March 31 occurring 0.25 miles or more from bald eagle use areas.

- Jackhammer or rock drill use between January 1 and August 15 or between October 31 and March 31 occurring more than 0.25 miles from bald eagle use areas if not in line of sight.

- Jackhammer or rock drill use between January 1 and August 15 or between October 31 and March 31 occurring more than 0.5 miles from bald eagle use areas if within line of sight.

- Use of large helicopter or aircraft between January 1 and August 15 or between October 31 and March 31 at a distance of 1 mile or more from bald eagle use areas.

- Use of helicopter or single-engine aircraft between January 1 and August 15 or between October 31 and March 31 at a distance of 1 mile or more from bald eagle use areas.

- Use of heavy equipment and motorized tools between January 1 and August 15 or between October 31 and March 31 more than 0.25 miles from bald eagle use areas if not in line of sight.

- Use of heavy equipment and motorized tools between January 1 and August 15 or between October 31 and March 31 more than 0.5 miles from bald eagle use areas if within line of sight.

- Prescribed burning activities between January 1 and August 15 or between October 31 and March 31 at a distance of 1 mile or more from bald eagle use areas.

Many project types may warrant a determination of *likely to adversely affect* bald eagles. Examples of such projects include the following:

- Blasting activities between January 1 and August 15 or between October 31 and March 31 less than 1 mile from bald eagle use areas.

- Impact pile driving activities between January 1 and August 15 or between October 31 and March 31 less than 0.25 miles from bald eagle use areas.

- Jackhammer or rock drill use between January 1 and August 15 or between October 31 and March 31 less than 0.25 miles from bald eagle use areas if not in line of sight.

- Jackhammer or rock drill use between January 1 and August 15 or between October 31 and March 31 less than 0.5 miles from bald eagle use areas if in line of sight.

- Use of large helicopter or aircraft between January 1 and August 15 or between October 31 and March 31 less than 1 mile from bald eagle use areas.

- Use of helicopter or single-engine aircraft between January 1 and August 15 or between October 31 and March 31 less than 1 mile from bald eagle use areas.

- Use of heavy equipment or motorized tools between January 1 and August 15 or between October 31 and March 31 less than 0.25 miles from bald eagle use areas if not in line of sight.

- Use of heavy equipment and motorized tools between January 1 and August 15 or between October 31 and March 31 less than 0.5 miles from bald eagle use areas if within line of sight.

- Prescribed burning activities between January 1 and August 15 or between October 31 and March 31 less than 1 mile from bald eagle use areas.

13.2.1.3 Marbled Murrelet

Marbled murrelets are sensitive to human disturbance, especially during the nesting season. Loss of suitable nesting habitat is one of the primary threats to marbled murrelet survival. Effect determinations are highly dependent upon the proximity of project activity to potential nesting areas and foraging habitat, activity noise levels, removal of suitable nesting habitat, and project timing in relation to the nesting season.

Many project types may warrant a determination of *no effect* on marbled murrelets. Examples of such projects include the following:

- Any project located more than 55 miles from marine waters.
- Any project or activity (including blasting) conducted within or outside suitable marbled murrelet nesting habitat, but outside the murrelet breeding season (April 1 through September 15), that does not remove suitable nesting habitat.
- Any project or activity conducted more than 60 yards (1 mile for blasting) from suitable marbled murrelet nesting habitat.
- Blasting activities between September 16 and March 30 that do not remove suitable marbled murrelet nesting habitat.
- Blasting activities between August 6 and September 15 occurring more than 1 mile from suitable marbled murrelet habitat.
- Use of impact pile drivers, jackhammers, or rock drills between September 16 and March 30.
- Use of impact pile drivers, jackhammers, or rock drills between August 6 and September 15 occurring more than 60 yards from suitable marbled murrelet habitat.
- Use of large helicopter or aircraft between September 16 and March 30.
- Use of large helicopter or aircraft between August 6 and September 15 more than 1 mile from suitable marbled murrelet habitat.
- Use of helicopter or single-engine aircraft between September 16 and March 30.
- Use of helicopter or single-engine aircraft between August 6 and September 15 more than 120 yards from suitable marbled murrelet habitat.
- Use of heavy equipment or motorized tools between September 16 and March 30 in the vicinity of suitable marbled murrelet habitat without affecting suitable habitat.

- Use of heavy equipment or motorized tools between August 6 and September 15 more than 35 yards from suitable marbled murrelet habitat without affecting suitable habitat.

- Use of chainsaws for felling trees and cutting downed wood between September 16 and March 30 without affecting suitable marbled murrelet habitat.

- Use of chainsaws for felling trees and cutting downed wood between August 6 and September 15 more than 45 yards from suitable marbled murrelet habitat.

- Any prescribed burning activities between September 16 and March 30.

Many project types may warrant a determination of *may affect but is not likely to adversely affect* marbled murrelets. Examples of such projects include the following:

- Activities conducted between April 1 and September 15 within 0.25 miles of suitable marbled murrelet nesting habitat, without producing noise above ambient levels or removing or disturbing suitable habitat.

- Activities (with the exception of blasting) conducted within 0.25 miles of suitable marbled murrelet nesting habitat, after August 5 and before September 15 between 2 hours after sunrise and 2 hours before sunset, or between September 15 and April 1, that result in increased human activity, disturbance, and noise above ambient levels but do not affect suitable habitat.

- Blasting activities between April 1 and August 5 occurring more than 1 mile from suitable marbled murrelet habitat.

- Blasting activities between August 6 and September 15 occurring less than 1 mile from suitable marbled murrelet habitat.

- Use of impact pile drivers, jackhammers, or rock drills between April 1 and August 5 more than 60 yards from suitable marbled murrelet habitat.

- Use of impact pile drivers, jackhammers, or rock drills between August 6 and September 15 less than 60 yards from suitable marbled murrelet habitat.

- Use of large helicopter or aircraft between April 1 and August 5 more than 1 mile from suitable marbled murrelet habitat.

- Use of large helicopter or aircraft between August 6 and September 15 less than 1 mile from suitable marbled murrelet habitat.

- Use of helicopter or single-engine aircraft between April 1 and August 5 more than 120 yards from suitable marbled murrelet habitat.
- Use of helicopter or single-engine aircraft between August 6 and September 15 less than 120 yards from suitable marbled murrelet habitat.
- Use of heavy equipment or motorized tools between April 1 and August 5 more than 35 yards from suitable marbled murrelet habitat.
- Use of heavy equipment or motorized tools between August 6 and September 15 less than 35 yards from suitable marbled murrelet habitat without affecting suitable habitat.
- Use of chainsaws for felling trees and cutting downed wood between April 1 and August 5 more than 45 yards from suitable marbled murrelet habitat.
- Use of chainsaws for felling trees and cutting downed wood between August 6 and September 15 less than 45 yards from suitable marbled murrelet habitat without affecting suitable habitat.
- Prescribed burning activities between April 1 and August 5 occurring more than 0.25 miles from suitable marbled murrelet habitat.
- Prescribed burning activities between August 6 and September 15 occurring less than 0.25 miles from suitable marbled murrelet habitat.

Examples of project types that may warrant a determination of *likely to adversely affect* marbled murrelets include the following:

- Blasting activities between April 1 and August 5 occurring less than 1 mile from suitable marbled murrelet habitat.
- Use of impact pile driver, jackhammer, or rock drill between April 1 and August 5 less than 60 yards from suitable marbled murrelet habitat.
- Use of large helicopter or aircraft between April 1 and August 5 less than 1 mile from suitable marbled murrelet habitat.
- Use of helicopter or single-engine aircraft between April 1 and August 5 less than 120 yards from suitable marbled murrelet habitat.
- Use of heavy equipment or motorized tools between April 1 and August 5 less than 35 yards from suitable marbled murrelet habitat.
- Use of chainsaws for felling trees and cutting downed wood between April 1 and August 5 less than 45 yards from suitable marbled murrelet habitat.

- Prescribed burning activities between April 1 and August 5 occurring less than 0.25 miles from suitable marbled murrelet habitat.
- Removal of suitable marbled murrelet nesting habitat, including trees with suitable nesting platforms.

13.2.1.4 Northern Spotted Owl

Projects that involve clearing of mature coniferous forest could adversely affect spotted owl habitat. Loss of suitable nesting habitat is one of the primary threats to spotted owl survival. Conditions for NE and NLTAA effect determinations depend upon proximity of the project activity to nesting habitat, activity noise levels, modification of suitable habitat, and timing of activity in relation to the nesting season.

Many project types may warrant a determination of *no effect* on spotted owls. Examples of such projects include the following:

- Activities conducted in counties that do not contain suitable spotted owl habitat.
- Activities conducted both outside the spotted owl breeding season (March 1 to September 30) and outside suitable habitat.
- Activities conducted at any time within suitable spotted owl habitat that 1) produce noise at or below ambient noise levels, 2) produce human disturbance levels at or below normal, and 3) do not modify suitable habitat.
- Activities that do not modify suitable spotted owl habitat, conducted at any time, where all suitable habitat within 0.25 miles of the project (1 mile for blasting) has been surveyed to protocol and no spotted owl activity centers have been located.
- Any blasting activities between October 1 and February 28.
- Blasting activities between July 16 and September 30 occurring more than 1 mile from suitable spotted owl habitat.
- Use of impact pile drivers, jackhammers, or rock drills between October 1 and February 28.
- Use of impact pile drivers, jackhammers, or rock drills between July 16 and September 30 more than 60 yards from suitable spotted owl habitat.
- Use of large helicopter or aircraft between October 1 and February 28.

- Use of large helicopter or aircraft between July 16 and September 30 more than 1 mile from suitable spotted owl habitat.
- Use of helicopter or single-engine aircraft between October 1 and February 28.
- Use of helicopter or single-engine aircraft between July 16 and September 30 more than 120 yards from suitable spotted owl habitat.
- Use of heavy equipment or motorized tools between October 1 and February 28.
- Use of heavy equipment or motorized tools between July 16 and September 30 more than 35 yards from suitable spotted owl habitat.
- Use of chainsaws for felling trees and cutting downed wood between October 1 and February 28.
- Use of chainsaws for felling trees and cutting downed wood between July 16 and September 30 more than 65 yards from suitable spotted owl habitat.
- Prescribed burning activities between October 1 and February 28 occurring more than 0.25 miles from suitable spotted owl habitat.

It is assumed that suitable spotted owl habitat would not be modified as a result of the conditions listed above.

Many project types may warrant a determination of *may affect but is not likely to adversely affect* spotted owls. Examples of such projects include the following:

- Noise-generating construction activities (excluding blasting) conducted during the spotted owl breeding season (March 1 through September 30) more than 0.25 miles from known spotted owl activity centers without modifying suitable habitat.
- Noise-generating construction activities (excluding blasting) conducted outside the spotted owl breeding season (October 1 to February 28) but within suitable habitat, without modifying suitable habitat.
- Activities that produce noise above ambient levels, conducted during the early breeding season (March 1 to July 15), within 0.25 miles of known spotted owl activity centers that are nonnesting for the year, without modifying suitable habitat.
- Blasting activities between March 1 and July 15 occurring more than 1 mile from suitable spotted owl habitat.

- Blasting activities between July 16 and September 30 occurring less than 1 mile from suitable spotted owl habitat.
- Use of impact pile drivers, jackhammers, or rock drills between March 1 and July 15 more than 60 yards from suitable spotted owl habitat.
- Use of impact pile drivers, jackhammers, or rock drills between July 16 and September 30 less than 60 yards from suitable spotted owl habitat.
- Use of large helicopter or aircraft between March 1 and July 15 more than 1 mile from suitable spotted owl habitat.
- Use of large helicopter or aircraft between July 16 and September 30 less than 1 mile from suitable spotted owl habitat.
- Use of helicopter or single-engine aircraft between March 1 and July 15 more than 120 yards from suitable spotted owl habitat.
- Use of helicopter or single-engine aircraft between July 16 and September 30 less than 120 yards from suitable spotted owl habitat.
- Use of heavy equipment or motorized tools between March 1 and July 15 more than 35 yards from suitable spotted owl habitat.
- Use of heavy equipment or motorized tools between July 16 and September 30 less than 35 yards from suitable spotted owl habitat.
- Use of chainsaws for felling trees and cutting downed wood between March 1 and July 15 more than 65 yards from suitable spotted owl habitat.
- Use of chainsaws for felling trees and cutting downed wood between July 16 and September 30 less than 65 yards from suitable spotted owl habitat.
- Prescribed burning activities between March 1 and July 15 occurring more than 0.25 miles from suitable spotted owl habitat.
- Prescribed burning activities between July 16 and September 30 occurring less than 0.25 miles from suitable spotted owl habitat.

It is assumed that suitable owl habitat would not be modified as a result of most of the conditions listed above.

Examples of project types that may warrant a determination of *likely to adversely affect* northern spotted owls include the following:

- Blasting activities conducted between March 1 and July 15 less than 1 mile from suitable spotted owl habitat.
- Use of impact pile drivers, jackhammers, or rock drills between March 1 and July 15 less than 60 yards from suitable spotted owl habitat.
- Use of large helicopter or aircraft between March 1 and July 15 less than 1 mile from suitable spotted owl habitat.
- Use of helicopter or single-engine aircraft between March 1 and July 15 less than 120 yards from suitable spotted owl habitat.
- Use of heavy equipment or motorized tools between March 1 and July 15 less than 35 yards from suitable spotted owl habitat.
- Use of chainsaws for felling trees and cutting downed wood between March 1 and July 15 less than 65 yards from suitable spotted owl habitat.
- Prescribed burning activities between March 1 and July 15 occurring less than 0.25 miles from suitable spotted owl habitat.

13.2.1.5 Gray Wolf

Wolves are considered most sensitive to disturbance at their den and rendezvous sites. Effect determinations depend upon the proximity of project activities to den and rendezvous sites, activity noise level, modification of suitable habitat, and timing of the activity in relation to critical time periods (e.g., the calving period).

Examples of project types that may warrant a determination of *no effect* on gray wolves include the following:

- All projects located outside suitable gray wolf habitat.
- Projects located within Yakima, Kittitas, Chelan, Okanogan, Ferry, Stevens, Spokane, Asotin, Columbia, Garfield, Walla Walla, and Pend Oreille counties that do not involve clearing of native vegetation and will not produce noise above ambient levels.
- All projects located within the developed limits of a city or town in Kittitas, Yakima, Chelan, Okanogan, Ferry, Stevens, Spokane, Asotin, Columbia, Garfield, Walla Walla, and Pend Oreille counties.

Examples of project types that may warrant a determination of *may affect but is not likely to adversely affect* gray wolves include the following:

- Activities generating noise above ambient levels within 0.5 miles of a known gray wolf den or rendezvous site outside the critical denning and rendezvous period (between July 1 and March 14).

- Activities conducted within a known gray wolf territory in occupied ungulate calving, fawning, or kidding grounds, generating noise above ambient levels (or otherwise creating disturbance within occupied ungulate wintering areas), outside the wintering period (between April 16 and November 30) and outside the calving period (between June 16 and November 30).

- Activities conducted within 0.25 miles of an active, developed transportation corridor outside known, occupied wolf territories and occupied ungulate calving, fawning, or kidding grounds.

- Activities that occur within 0.5 miles of a known gray wolf den or rendezvous site without generating noise above ambient levels.

- Activities (excluding blasting and pile driving) that occur within 300 feet of a developed transportation corridor.

13.2.1.6 Woodland Caribou

Habitat loss and fragmentation, mortality associated with human activities, and natural predation are the greatest threats to woodland caribou in Washington. Effect determinations are dependent upon proximity of project activity to the known range of caribou, suitable habitat, or documented habitat.

Examples of project types that may warrant a determination of *no effect* on woodland caribou include the following:

- Projects located outside Pend Oreille and Stevens counties.

- Projects located in Pend Oreille and Stevens counties within the developed limits of a city or town.

- Projects located outside suitable or documented woodland caribou habitat.

13.2.1.7 Pygmy Rabbit

The primary cause of decline of the pygmy rabbit is loss of thick sagebrush habitat. The rabbit's dependency on a long-lived, slow-recovering food source (i.e., sagebrush) limits the potential for its rapid recovery. Effect determinations depend upon proximity of project activity to the known range of the pygmy rabbit and removal of suitable habitat.

Examples of project types that may warrant a determination of *no effect* on the pygmy rabbit include the following:

- Projects occurring outside Douglas County or Grant County.
- Projects occurring within Douglas County or Grant County but outside the present range of the pygmy rabbit.
- Projects occurring within the developed portion of the WSDOT right-of-way.
- Projects that do not involve removal of sagebrush or ground-disturbing activities within native shrub-steppe habitat.

Many project types may warrant a determination of *may affect but is not likely to adversely affect* the pygmy rabbit. An example follows:

- Projects located in Douglas County or Grant County within the WSDOT right-of-way, requiring removal of sagebrush, provided that the habitat outside the right-of-way is agricultural or developed.

13.2.1.8 Grizzly Bear

Projects located in the North Cascades, Okanogan Highlands, and Selkirk Mountains are most likely to encounter grizzly bears. Along existing developed transportation corridors, which are not considered high-quality grizzly bear habitat, project impacts on habitat typically are negligible. Effect determinations depend upon proximity of project activity to the known potential range of grizzly bear, activity noise levels, removal of native vegetation, and proximity of the activity to developed transportation corridors.

Examples of project types that may warrant a determination of *no effect* on grizzly bears include the following:

- Projects located outside counties known to support grizzly bear habitat.
- Projects located in counties containing grizzly bear habitat that do not involve clearing of native vegetation and will not produce noise above ambient levels.
- Projects located within the developed city limits of a town in counties known to support grizzly bear habitat.

Many project types may warrant a determination of *may affect but is not likely to adversely affect* grizzly bears. An example follows:

- Projects located within 0.25 miles of an active, developed transportation corridor within suitable grizzly bear habitat, provided that the habitat is not disturbed.

13.2.1.9 Wenatchee Mountains Checker-Mallow

Projects that involve ground-disturbing activities in wetland and riparian areas located in the Wenatchee Mountains could affect the Wenatchee Mountains checker-mallow. Effect determinations depend upon proximity of project activity to the known range of the Wenatchee Mountains checker-mallow and to wetlands, riparian areas, and suitable habitat.

Many project types may warrant a determination of *no effect* on Wenatchee Mountains checker-mallow. Examples of such projects include the following:

- Projects located outside Kittitas and Chelan counties.
- Projects located in Chelan and Kittitas counties that involve no ground-disturbing activities or are confined within the developed portion of the roadway.
- Projects located in Chelan and Kittitas counties but not in the Wenatchee Mountains and not between 1,600 and 3,300 feet elevation.
- Projects that do not remove or modify vegetation within 200 feet of wetlands or riparian areas and do not alter wetland hydrology.
- Project areas that do not contain suitable Wenatchee Mountains checker-mallow habitat, as determined by a survey conducted by a qualified biologist between June 15 and July 31.

Many project types may warrant a determination of *may affect but is not likely to adversely affect* Wenatchee Mountains checker-mallow. Examples of such projects include the following:

- Projects located in the Wenatchee Mountains between 1,600 and 3,300 feet elevation that alter vegetation within 61 meters (200 feet) of unsurveyed, potentially suitable Wenatchee Mountains checker-mallow habitat, but do not alter wetland or riparian vegetation or hydrology.
- Projects located in the Wenatchee Mountains between 1,600 and 3,300 feet elevation that alter potentially suitable Wenatchee Mountains checker-mallow habitat not containing Wenatchee Mountain checker-mallow, as documented by a survey conducted by a qualified biologist between June 15 and July 31.

13.2.1.10 Ute Ladies'-Tresses

Projects that involve ground-disturbing activities in wetland and riparian areas located in transition zones could affect Ute ladies'-tresses (*Spiranthes diluvialis*). Effect determinations depend upon proximity of project activity to wetlands, riparian areas, and suitable habitat.

Many project types may warrant a determination of *no effect* on Ute ladies'-tresses. Examples of such projects include the following:

- Projects that do not involve ground-disturbing activities.
- Projects that do not alter wetland hydrology and that do not remove or modify vegetation within 200 feet of wetlands or riparian areas suitable for supporting Ute ladies'-tresses, as identified by the project biologist.
- Projects located above 7,000 feet elevation.

Many project types may warrant a determination of *may affect but is not likely to adversely affect* Ute ladies'-tresses. Examples of such projects include the following:

- Project areas that do not contain Ute ladies'-tresses, as determined by a survey conducted by a qualified biologist between July 15 and September 15.
- Project areas that do not contain Ute ladies'-tresses, as determined by a survey conducted by a qualified biologist between July 1 and September 15.
- Projects located between sea level and 7,000 feet elevation that alter vegetation within 200 feet of unsurveyed, potentially suitable Ute ladies'-tresses habitat, but do not alter wetland or riparian vegetation or hydrology.

13.2.1.11 Water Howellia

The most significant threats to water howellia (*Howellia aquatilis*) include changes in wetland hydrology, increases in weedy species, livestock grazing, and timber harvest on adjacent uplands (WDNR and USDI BLM 1999). Effect determinations depend upon proximity of project activity to the known range of water howellia and suitable wetland habitat.

Many project types may warrant a determination of *no effect* on water howellia. Examples of such projects include the following:

- Projects that do not involve ground-disturbing activities.
- Projects conducted entirely within the developed portion of the roadway that do not modify vegetation or hydrology in adjacent wetlands.

- Projects located above 2,300 feet elevation.
- Projects or activities involving the alteration of habitat not suitable to water howellia, as identified by the project biologist.

Many project types may warrant a determination of *may affect but is not likely to adversely affect* water howellia. An example follows:

- Projects that disturb suitable habitat that does not contain water howellia, as determined by a survey conducted between May 25 and July 15 by a qualified biologist.

13.2.1.12 Spalding's Catchfly

Projects that involve ground-disturbing activities in native grasslands could affect Spalding's catchfly (*Silene spaldingii*). Effect determinations depend upon proximity of project activity to the known range of Spalding's catchfly and its suitable habitat.

Many project types may warrant a determination of *no effect* on Spalding's catchfly. Examples of such projects include the following:

- Projects that occur outside Adams, Asotin, Garfield, Lincoln, Spokane, and Whitman counties.
- Projects located within Adams, Asotin, Garfield, Lincoln, Spokane, and Whitman counties that do not involve ground-disturbing activities.
- Projects that do not remove or modify native grassland habitat located in Adams, Asotin, Garfield, Lincoln, Spokane, and Whitman counties.
- Project areas that do not contain Spalding's catchfly, as determined by a survey conducted by a qualified biologist between July 15 and August 31.

13.2.2 Effect Determinations for Proposed Species

Effect determinations for proposed species are addressed briefly in the previous chapter.

13.2.3 Effect Determinations for Candidate Species

As stated throughout this manual, information concerning candidate species should be included in an appendix to the BA. The following sections provide some guidance regarding effect determinations for the bird, small mammal, amphibian, butterfly, and plant species that are candidate species for listing by the USFWS.

Conditions for *not likely to impact populations or suitable habitat* determinations depend upon proximity of project activity to the known range of the species and disturbance to suitable habitat.

13.2.3.1 Western Sage Grouse

Projects meeting one or more of the following conditions *are not likely to impact populations, individuals, or suitable habitat* of the western sage grouse:

- Projects occurring outside Douglas, Grant, Kittitas, Okanogan, or Yakima counties.
- Projects occurring outside the current range of the western sage grouse.
- Projects occurring within the developed portion of the WSDOT right-of-way.
- Projects that do not involve ground-disturbing activities within native shrub-steppe habitat.

13.2.3.2 Washington Ground Squirrel

Projects meeting one or more of the following conditions *are not likely to impact populations, individuals, or suitable habitat* of the Washington ground squirrel:

- Projects that do not occur in Douglas, Grant, Lincoln, Adams, Whitman, Columbia, Garfield, Walla Walla, and Franklin counties.
- Projects that do not involve ground-disturbing activities in native steppe or shrub-steppe habitat.

13.2.3.3 Columbia Spotted Frog

Projects meeting one or more of the following conditions *are not likely to impact populations, individuals, or suitable habitat* of the spotted frog:

- Projects that 1) implement BMPs preventing pollutants or runoff from entering surface water, 2) do not remove or modify aquatic or riparian vegetation, and 3) do not alter the existing hydrology of wetlands and streams.
- Project areas that do not contain populations of Columbia spotted frogs, as determined by a survey conducted by a qualified biologist.

13.2.3.4 Basalt Daisy

Projects meeting one or more of the following conditions are *not likely to impact populations, individuals, or suitable habitat* of basalt daisy (*Erigeron basalticus*):

- Projects located outside the Yakima Canyon and Selah Creek vicinity.
- Projects located within the Yakima Canyon and along Selah Creek that do not involve ground-disturbing activity or modify basalt cliffs.
- Project areas that do not contain basalt daisy, as determined by a survey conducted by a qualified biologist between May 1 and October 31.

13.2.3.5 Northern Wormwood

Projects meeting one or more of the following conditions *are not likely to impact populations, individuals, or suitable habitat* of northern wormwood (*Artemesia campestris*):

- Projects located outside the SR 243 corridor in Grant County.
- Projects that involve no ground-disturbing activities.
- Project areas that do not contain northern wormwood, as determined by a survey conducted by a qualified biologist during April.

13.2.3.6 Umtanum Desert Buckwheat

Projects meeting one of the following conditions *are not likely to impact populations, individuals, or suitable habitat* of Umtanum desert buckwheat (*Eriogonum codium*):

- Projects not located on the Lolo Basalt Flow or near basalt cliffs along the Columbia River where associated species are present.
- Projects areas that do not contain Umtanum desert buckwheat, as determined by a survey conducted by a qualified biologist between May 1 and August 31.

13.2.3.7 White Bluffs Bladder-Pod

Projects meeting one or more of the following conditions *are not likely to impact populations, individuals, or suitable habitat* of White Bluffs bladder-pod (*Lesquerella tuplashensis*):

- Projects not located in Franklin and Grant counties.
- Projects located in Franklin and Grant counties that do not involve ground-disturbing activities.

- Projects that do not encounter caliche soils.
- Project areas that do not contain White Bluffs bladder-pod, as determined by a survey conducted by a qualified biologist between June 15 and July 31.
- Projects not located between 780 and 890 feet elevation.

13.2.3.8 Slender Moonwort

Projects meeting one or more of the following conditions *are not likely to impact populations, individuals, or suitable habitat* of slender moonwort (*Botrychium lineare*):

- Projects located outside the Colville National Forest boundary in Ferry County.
- Projects that involve no ground-disturbing activities.

13.3 Effect Determinations for Critical Habitat

The following sections provide guidance for making effect determinations for critical habitat of NOAA Fisheries listed fish species and critical habitat of USFWS listed Wenatchee Mountain checker-mallow and northern spotted owl.

Effect determinations for critical habitat should provide information on the primary constituent elements (PCEs) affected, briefly describe how they will be affected, and explain how these impacts influence the overall effect determination for critical habitat.

13.3.1 NOAA Fisheries Listed Fish Species Critical Habitat

The following compilation of conditions for effect determinations was generated from all of the program descriptions in the NOAA Fisheries programmatic BA. Many of the conditions apply to more than one program description. Most of the conditions are identical to the conditions used to make effect determinations for listed fish species. Conditions for effect determinations depend upon numerous factors, including presence of critical habitat, presence of listed fish species, proximity of project activity to surface waters, level of disturbance, ability to contain project activity within previously developed areas, use of appropriate BMPs, extent of riparian vegetation removal, restriction of work to appropriate work windows, and compliance with established guidelines, agreements, and permits.

Many project types may warrant a determination of *no effect* on critical habitat. Examples of such projects include the following:

- Projects with action areas located outside critical habitat.

- Projects located within critical habitat that 1) are conducted entirely within the developed portion of the roadway, 2) do not remove or modify vegetation in any way, 3) do not alter existing hydrology through modified discharges, and 4) do not discharge materials (such as water, asphalt grindings, or fill material) from the developed portion of the roadway.

- Bridges undergoing seismic retrofit, bridge deck repair, overlays, or replacements, provided that they involve no in-water work and create no additional impervious surface area.

- Projects located where there are no listed species-bearing waters within the action area.

Many project types may warrant a determination of *may affect but is not likely to adversely affect* critical habitat. Examples of such projects include the following:

- Projects located within 300 feet of the ordinary high water mark (OHWM) of a listed fish-bearing water that do not remove or alter riparian habitat.

- Projects in which slide material has entered a listed fish-bearing water body and, if removal is necessary, will be conducted within the appropriate work window when listed fishes are not likely to be present in the action area.

- Activities that involve work below the OHWM to replace or extend culverts, provided that there are no ESA-listed salmonid species present in the system during the approved work window. (Road crossing replacement culverts will be designed in accordance with *Fish Passage Design at Road Culverts: A Design Manual for Fish Passage at Road Crossings* (WDFW 1999). Tide gate replacement projects should follow the guidance in the programmatic biological opinion: *Phase II Fish Passage Restoration, Department of Army Permits* [11/19/01]).

- Projects that relocate streams farther away from the roadway or separate ditch/stream systems, provided that listed salmonid species are not present in the system during construction, and the activity restores or improves habitat functions provided by the original channel through creation of meanders, vegetated stream banks, or installation of habitat structures.

- Projects that replace existing riprap structures with no expansion of the original footprint based on the as-built plans, or projects that remove an equivalent amount of riprap within the project area during a period when listed fish species are not likely to be present.

- Projects that use blasting as a method of removing slide materials, with the blast and the fallout of materials occurring outside the aquatic system, provided that the blasting occurs within the designated work windows if listed fishes are known to be present in the immediate vicinity (one-quarter mile) upstream and downstream.

- Floating bridge maintenance projects consisting of the repair or replacement of floating bridge cables or the removal of derelict fishing nets.

13.3.2 Wenatchee Mountains Checker-Mallow

Many project types may warrant a determination *of no effect* on designated critical habitat for the Wenatchee Mountains checker-mallow (*Sidalcea oregana* var. *calva*). Examples of such projects include the following:

- Projects located entirely within WSDOT right-of-way that do not alter the hydrology of critical habitat for the Wenatchee Mountains checker-mallow.

- Projects located outside WSDOT right-of-way and critical habitat that do not alter the hydrology of critical habitat for the Wenatchee Mountains checker-mallow.

Many project types may warrant a determination of *may affect but is not likely to adversely affect* designated critical habitat for the Wenatchee Mountains checker-mallow. Examples of such projects include the following:

- Projects that may alter the hydrology of critical habitat for the Wenatchee Mountains checker-mallow but will not adversely affect primary constituent elements.

13.3.3 Northern Spotted Owl

Many project types may warrant a determination of *no effect* on spotted owl suitable or critical habitat. Examples of such projects include the following:

- Activities conducted in counties that are outside the range of the Northern Spotted Owl.

- Activities that occur outside designated spotted owl critical habitat or suitable habitat.

- Activities conducted within spotted owl critical habitat that do not modify or remove suitable owl habitat, habitat components, or constituent elements of the stand.

Many project types may warrant a determination of *may affect but is not likely to adversely affect* spotted owl suitable or critical habitat. Examples of such projects include the following:

- Activities that modify younger stands within areas designated as critical habitat and that are not likely to impede development of constituent elements. Habitat areas located on federal land (e.g., national forest or national park lands) or state or private lands covered by a HCP may be modified only if the removal is consistent with the requirements of those lands.

- Activities that result in short-term degradation of dispersal habitat but are not likely to adversely degrade its suitability as dispersal habitat. Habitat areas located on federal land (e.g., national forest or national park lands) or state or private lands covered by a HCP may be modified only if the removal is consistent with the requirements of those lands.

- Activities that involve minimal modification of less than 5 acres per region per year of dispersal habitat located within areas designated as critical habitat. Habitat areas located on federal land (e.g., national forest or national park lands) or state or private lands covered by a HCP may be modified only if the removal is consistent with the requirements of those lands.

Many project types may warrant a determination of *may adversely affect* spotted owl suitable or critical habitat. Examples of such projects include the following:

- Activities involving moderate modification of less than 5 acres per region, per year, of currently suitable habitat located within 100 feet of an existing developed transportation corridor, that may degrade the constituent elements, provided that such activity does not occur within 0.25 miles of known spotted owl activity centers or is conducted outside the breeding season (October 1 to February 28). Habitat areas located on federal land (e.g., national forest or national park lands) or state or private lands covered by a HCP may be modified only if the removal is consistent with the requirements of those lands.

14.0 In-Water Work

14.0 In-Water Work

Chapter Summary

- Describe specific methods, materials, and techniques of in-water construction elements of the project.
- Describe the duration and logistics of proposed in-water work.
- Discuss the timing of in-water work in relation to the presence of different life stages of listed species within the project action area, and also in relation to the in-water work windows stipulated by the WDFW area habitat biologist or the hydraulic project approval (HPA).
- Quantify anticipated impacts associated with the proposed activities.
- Describe stream bypass and fish handling or exclusion methods, if applicable.
- Discuss the extent of potential direct and indirect effects of proposed actions on habitat and various life stages of fish species that are present.
- When assessing impacts, consider impact minimization measures and BMPs that will be implemented to minimize project impacts.
- See guidance at the end of this chapter for effect determination considerations; also see PART 2: EFFECT DETERMINATION GUIDANCE.

14.1 General Considerations

This chapter provides general guidance on how to approach the analysis of effects associated with in-water work, examples of well written analyses of in-water work and its effects, general information and resources for understanding in-water work issues and activities, and specific guidance for making effect determinations pertaining to in-water work.

Frequently, BAs lack sufficient information regarding proposed in-water work. It is essential that the discussion of in-water elements of a proposed project consider the following issues:

- Discuss specific methods of in-water construction.
- Discuss methods for determining culvert size.
- Discuss the duration of in-water work.
- Discuss the location of machinery, equipment, and staging areas in relation to the stream channel.

- Provide the amount of material to be placed along the channel banks and the amount of material to be placed within the wetted channel (e.g., fill, large woody debris, or boulders).
- Discuss whether piles will be driven by vibratory or impact methods.
- Describe stream bypass methods.
- Discuss the extent of riparian vegetation removal and ground disturbance proposed in the vicinity of the water resource.
- Discuss the extent of potential direct and indirect effects of proposed actions on habitat and various life stages of fish species present.
- Consider the types of piles proposed and associated potential contaminants: treated wood (e.g., creosote, chromated copper arsenate (CCA), or polycyclic aromatic hydrocarbon compounds [PAHs]), cast-in-place or concrete piles (e.g., pH alterations or lime), or metal (e.g., treated or PVC coatings).
- Consider the impacts of removing piles: in some cases, sawing concrete piles off at the water line rather than at or below the mud line reduces impacts by preventing alterations to the pH of the water body. Removal of treated wood piles may have short-term adverse impacts resulting from the resuspension of contaminants but may improve environmental baseline conditions in the long term.
- Consider whether cofferdams will increase sediment impacts or effectively contain sediments so that sediments can be pumped to infiltration sites. Consider using water sausages to decrease sediment impacts.
- Consider sediment impacts resulting from bank trampling and compaction.
- Consider the impacts resulting from first flush: will the first rains after construction generate sediment loads above the natural disturbance regime, thus constituting an adverse effect?
- Discuss the quantity of sedimentation and dispersion (i.e., will it amount to a teaspoon or a truckload in a small or large system).
- Consider the size of the mixing zone and the behavior of sediments suspended in the water column. How far will sediment impacts extend? Is this extent of impact compatible with Department of Ecology guidelines for mixing zones?
- Describe conservation and BMP measures that will be implemented to minimize construction-related impacts.

- Discuss the timing of in-water work in relation to the presence of different life stages of listed species within the project action area.
- Describe work occurring within the in-water work windows stipulated by the WDFW area habitat biologist or the hydraulic project approval.
- If the project occurs in a seasonal stream when the channel is dry, describe the cleanup measures and the effect of first-flush impacts.

14.2 Example of a BA Section Addressing In-Water Work

The BA excerpt below provides a good discussion of proposed in-water work (in a marine area) including construction elements, methods, and related impact minimization measures:

> The project will result in the removal of approximately 530 creosote treated timber piles, 20 plastic and steel piles, as well as timber walls and rub-face timbers associated with dog-leg wingwalls. The timber dolphins will be replaced with six new steel pile dolphins comprising 70 piles. The new dolphins will be installed in a configuration similar to existing structures. Table 14-1 details structures that will be removed and structures that will be installed.

Table 14-1. In-water structures to be removed and installed.

Structure	Depth (MLLW)	Structural Components Removed	Structural Components Installed
Slip A			
Left inner dolphin	–16 ft	35 creosote-treated piles	One 6-steel-pile dolphin
Right dogleg wingwall	–24 ft	78 creosote-treated piles and additional wingwall timbers	One 6-steel-pile dolphin
Left outer dolphin	–33 ft	80 creosote-treated piles	One 12-steel-pile dolphin
Slip B			
Left dogleg wingwall	–24 ft	78 creosote-treated piles and additional wingwall timbers	One 6-steel-pile dolphin
Slips A and B			
Right outer dolphin (slip A) and left outer dolphin (slip B)	–35 ft	Two 100-pile creosote-treated timber dolphins	One 25-steel-pile double sided dolphin
Tie-up slip			One 9-steel-pile dolphin
Outer dolphin	–35 ft	61 creosote-treated piles	
Total		Approximately 530 piles[a]	64 steel piles plus six contingency piles[b]

[a] Some dolphins have been stabilized with steel piles and faced with plastic piles; hence the exact number of creosote piles may vary slightly. Approximately 20 steel/plastic piles are included in the total number of piles removed.

[b] Because of design uncertainties at this time, Washington State Ferries is factoring 10 percent more steel piles than may be necessary, to account for design changes during the latter phases of construction.

> The project proponent is currently in the early stage of design engineering for the project. For this reason, the actual number and size of piles to be used may change slightly. In order to expedite the project, and avoid future permit or permit application revisions, the action agency has calculated the total number of piles to include a 10 percent contingency factor that will allow for minor design changes later in the design process. The project plan at this early design stage calls for the dolphins to be constructed using 64 steel piles. The action agency is requesting authorization to install up to 70 piles, which includes a 10 percent (or six-pile) contingency factor.
>
> Removal and replacement of the structures will be phased depending upon time and availability of funding for the project. Dolphin removal and replacement will begin during the fall in-water work window of 2001 (September 14–November 1) and may continue after the spring fish window in 2002 (July 17–September 13). All in-water work will be completed within the approved in-water work windows. Replacement of the dogleg wingwalls will be based on availability of funding.

The BA then systematically describes the process of timber dolphin and wingwall removal and the minimization measures associated with these activities:

> To remove existing dolphins, the tops of the dolphins will be unfastened and lashing or other connections between the timber piles will be removed. A vibratory hammer or a choker cable will be used to lift the broken piles from the sediment. Once the first few piles associated with the dolphin are removed, the remaining piles come out of the sediment with ease because pressure and suction on the piles has been alleviated.
>
> The dogleg wingwalls can be removed by either of two methods. The above-water portion of the wingwall can be dismantled, and the piles can be removed using a vibratory hammer/extractor; or the piles can be cut off above the water line during a low tide and the above-water portion of the wingwall can be removed in one piece. Using the latter method, above-water sections of the wingwall will come out in one piece and be taken upland and dismantled, reducing the amount of in-water work and the potential loss of associated debris into the water. The remaining pile stubs will be removed with a clamshell bucket. The clamshell bucket replaces the hammer on the derrick, and the pile is grabbed and slowly pulled up. A small clamshell bucket is used to minimize disturbance to bottom sediments.
>
> The method selected to remove wingwalls will depend upon the condition of the wingwalls and favorable tides at the time of demolitions. During pile removal, the removed piles are set to the side of the barge until pile removal is complete. Pulled timber piles either float horizontally on the water, or if they are heavily waterlogged, are set vertically along the side of the barge. Once all piles have been pulled, the piles are lifted onto the barge with a choker cable. Broken pile stubs and associated sediments (if any) are loaded onto a temporary storage area on the barge.
>
> The temporary storage area will be lined with an erosion control blanket, filter fabric, or straw bales placed around the perimeter to separate sediments from

runoff from the barge. Any water from either extraction method will be filtered through the sediment containment material on the barge before reentering Puget Sound, in compliance with WAC 173-201(A)-100 and the Washington departments of ecology and transportation implementing agreement regarding surface water quality standards.

Minimization Measures

Minimization measures to be employed during pile removal include:

- All creosoted material, pile stubs, and associated sediments shall be disposed of by the contractor in a landfill, which meets the liner and leachate standards of the minimum functional standards, Chapter 173-304 WAC. The contractor will provide receipts of disposal to the project engineer.
- Piles that break below the waterline shall be removed with a clamshell bucket. The size of the clamshell shall not exceed 3.5 cubic yards to minimize disturbance to bottom sediments.
- Piles, stubs, and associated sediments (if any) shall be contained on a barge. The storage area shall consist of a row of hay or straw bales, or filter fabric, placed around the perimeter of the barge. The arrangement of the containment area shall meet the approval of the project engineer.
- An oil containment boom shall be employed during creosote piling removal activities. The boom shall also serve to collect any floating debris that may occur from pile removal. Oil absorbent materials shall be employed if visible product is observed. The boom shall remain in place until all oily material and floating debris has been collected and sheens have been dissipated.

An example of the direct effects discussion addressing in-water work elements (for a culvert replacement project) is provided below. If a project with in-water work components requires removal of listed fish species (as a condition of an HPA), the project biologist must provide a *take* analysis. Any fish handling or moving requires an incidental *take* permit. The following example was supported by information provided in the appendix of the document, including the HPA and the proposed riparian planting plans.

Direct Effects

The proposed in-water work includes 1) The extension of two existing parallel 12-foot pipe arch culverts over Pine Creek that cross under SR 2 at the north end of the project; 2) Two new bottomless steel arch culverts over Pine Creek for the southbound on- and off-ramps near 6th Street; and 3) placing rock and large woody debris in Pine Creek in an approximately 640-meter (2,099-foot) section of the riparian zone as part of the riparian restoration plan, which is a WDFW mitigation requirement for the impacts of work in Pine Creek.

Extension of Pipe Arches

Construction of the steel pipe arch extensions under SR 2 north of 6th will be performed in the dry. It is anticipated that the work can be accomplished in the following sequence:

1. Since there are two pipe arches, the water will be diverted into one pipe by sand-bagging upstream while extending the other pipe.

2. The diversion will be switched to the second pipe in order to extend the first one. In addition, the concrete headwalls for the culvert extended in this phase will need to be completed.

3. The last phase involves diverting the water back to the same pipe as in phase one (the one with the headwall complete), and finishing construction of the headwall on the second pipe.

Because these culverts are fairly large, flow impacts should not be major if the work is completed during the lowest flow and ground water levels, which should correspond to the timing window required as a condition of the HPA. There is no foreseeable need for any temporary culverts in this sequence. There is, however, quite a bit of sediment in the bottom of these pipes that will need to be cleaned out to complete the work.

New Steel Arches

These two new culverts span 7.31 meters (24 feet). The off-ramp culvert is 34 meters (111 feet) long and the on-ramp culvert is 27 meters (88 feet) long.

The foundations for the new steel arches will need to be constructed in the dry. This will involve placing a temporary culvert in the streambed and sand bagging the upper end to ensure that all water goes in this temporary culvert. This will need to be completed during the lowest flow and ground water levels within the timing restriction contained in the HPA issued by WDFW. The areas where the foundations for the culverts are placed may need to be dewatered. Any pumping to facilitate dewatering will be directed to a location where the water has an opportunity to be filtered prior to reentering the creek. An estimated time necessary to construct each of the new culverts is fifteen to twenty calendar days. All new concrete will be allowed to cure prior to the creek being allowed to flow through the new culverts.

Riparian Restoration

The riparian planting of Pine Creek is a mitigation requirement of WDFW for the impacts of work in Pine Creek. WSDOT will plant approximately 640 meters (2,099 feet) of the riparian zone with deciduous and coniferous trees and shrubs. In addition, WSDOT will place rock habitat structures and large woody debris in the creek to diversify the habitat. The existing condition of the creek is a straight ditch almost 100 percent vegetated with reed canarygrass. The lack of woody species is directly attributable to past ditch dredging practices.

Potential Impacts Summary

Possible short-term adverse impacts on Pine Creek, some of which may have long-term beneficial effects, include temporary sedimentation during construction of the new and extended culverts, and during placement of in-stream structures and planting of the riparian zone.

The impacts on the Pine Creek system will be minimized by following all HPA conditions, including timing restrictions.

Accidental spills of deleterious materials or erosion and sedimentation are possible impacts for which planning and action is undertaken on all WSDOT projects. The contract for this project, as with all WSDOT projects, contains provisions for TESC and spill control and containment which, except in unusual circumstances, should prevent impacts on aquatic systems.

The project will result in an increased amount of impervious surface within the action area. Most all of the new impervious surface, plus a portion of the existing untreated impervious surface, will be treated for both quality and quantity. Treatment includes chemical and some physical constituents (sediment), but may result in increased water temperature and possible lowered oxygen levels in water discharging from the stormwater pond into receiving water bodies. Discharge rates from highway runoff facilities are designed so that flow timing in receiving water bodies is not adversely affected.

Because all of the project construction, except the wetland mitigation site, will occur outside the mapped floodplain, no direct impacts are anticipated. Lowering the ground elevation within the wetland mitigation site will provide an additional small amount of flood storage capacity in the system.

Impacts on critical habitat are likely to arise from the following activities: 1) installation and extension of culverts on Pine Creek; and 2) construction of a bridge crossing Pine Creek. These activities will require working in or near the water and may cause temporary increases in turbidity levels. Because 1) Pine Creek and the Maple River are already extremely turbid; and 2) there is no appreciable spawning habitat in Pine Creek and very little downstream in the Maple River (in the project vicinity), the effects of a temporary increase in turbidity are likely to be insignificant. Additionally, NOAA Fisheries notes, "Few if any effects would result from an activity where it is well documented that the listed species makes little use of a river reach or basin and the existing habitat conditions are poor" (50 CFR § 226, February 16, 2000). In conclusion, this investigation suggests that critical habitat in the project vicinity is in poor condition.

14.3 Information Resources

Information pertaining to the methods or construction techniques employed for in-water work is available from a number of sources, including but not limited to the sources listed below:

- WDFW: Hydraulic Project Approval Code (RCW 75.20 and WAC 220-110). Available online at <http://slc.leg.wa.gov/default.htm>.
- WDFW: *Fish Passage Design at Road Culverts—A Design Manual for Fish Passage at Road Crossings*. Available online at <http://wdfw.wa.gov/hab/engineer/cm/>.
- WDFW: *Integrated Streambank Protection Guidelines*. Available online at <http://wdfw.wa.gov/hab/ahg/strmbank.htm>.
- WDFW: *Fishway Design Guidelines for Washington State*. Available online at <http://wdfw.wa.gov/hab/ahg/fishguid.pdf>.
- *Best Management Practices to Protect Water Quality from Non-Point Source Pollution* (Warrington March 2000).

A summary of the activities regulated under the hydraulic code and their WAC citations are provided in Table 14-2. Additional guidelines and white papers referenced in Table 14-2 can be found online at <http://wdfw.wa.gov/hab/ahg/ahgwhite.htm>.

The Washington hydraulic code stipulates that all activities that alter the bed or flow of state waters (i.e., all in-water work) require a hydraulic project approval (HPA) permit from WDFW. Through the hydraulic code, WDFW is liable under the Endangered Species Act for any *take* that occurs as a result of projects it approves. In an effort to minimize impacts on species and avoid *take*, clear conditions are stipulated in the permits WDFW issues to project proponents, including in-water work windows.

WDFW area habitat biologists currently reference two state pamphlets for general guidance in determining in-water work windows: *Gold and Fish* and *Aquatic Plants and Fish* (see online citation below). The general timing restrictions stipulated in these documents are then modified by area biologists, based on their knowledge or observations of site-specific conditions, in order to provide sufficient habitat protection and minimize potential impacts on species.

The *Gold and Fish* pamphlet is available online at <http://www.wdfw.wa.gov/hab/goldfish/goldfish.htm>.

The *Aquatic Plants and Fish* pamphlet is available online at <http://wdfw.wa.gov/hab/aquaplnt/aquaplnt.pdf>.

By including HPA conditions in the BA impact minimization measures, project impacts can be reduced. However, the timing of the in-water work window as defined by WDFW in an HPA can differ from the window defined by NOAA Fisheries and USFWS, because the guidance used by WDFW habitat biologists in determining in-water work windows has not been formally approved by NOAA Fisheries and USFWS. The guidance used by state biologists emphasizes the sensitive periods for all species that WDFW addresses, not just listed fish species, and is

Table 14-2. Activities regulated by the hydraulic code (WAC 220-110).

General WAC Topic	Topic/Activities	WAC Reference	Guidance or Guideline Reference
Bank protection	Bulkheads (lakes), instream structures (weirs, spurs, vortex structures, groins, barbs), beach enhancement (lakes), vegetative additions, river channel confinement and construction impacts, levee construction and removal, diversion of floodplain/hyporheic flow (forcing, floodway conveyance, relocation), floodplain fill placement	220-110-050, 220-110-223	Integrated Streambank Protection Guidelines (WDFW)
On-water and over-water structures	Docks, piers, floats, rafts, ramps, boat hoists, launches, boathouses, houseboats and associated moorings, marinas, driving or removal of pilings, trash-booms, trash-racks, work-barges, dolphins	220-110-060, 220-110-224, 220-110-290, 220-110-300, 220-110-330	Aquatic Habitat Guidelines white papers (WDFW)
Water crossings	Beach access, bridges, fords	220-11-070	Fish Passage at Road Culverts guidelines, Fishway Design Guidelines (WDFW)
Culverts	Culverts - new and retrofits		Fish Passage at Road Culverts guidelines (WDFW)
Water diversions	Screening devices, damming (small scale), pump intakes	220-110-190	Fishway Design Guidelines, Irrigation and Fish pamphlet (WDFW)
Conduit crossings	Trench cuts, borings, aerial, surface placement	220-110-100, 220-110-310	
Dredging and gravel removal	Instream sediment sumps, gravel pits, floodplain pits, dredging, gravel removal	220-110-130, 220-110-140, 220-110-320	Aquatic Habitat Guidelines white papers (WDFW)
Felling and yarding of timber	Non-FPA activities in Type 4-5 waters	220-110-160	
Aquatic plant control	Hand pulling, cutting, raking, bottom barriers, weed rollers, mechanical harvesting and cutting, diver dredging, dragline and clamshell dredging, rotovation, chemical controls	220-110-331 through 220-110-338	Aquatic Plants and Fish pamphlet (WDFW)
Aquaculture	Net pens, shellfish racks, hatchery racks, egg tubes, fish traps (see topics document)	None	
Marine resource issues	Bulkheads, marine beach nourishment, marine shoreline and near-shore activities, estuary restoration, vegetation (eelgrass, kelp beds, wetland, estuary)	220-110-280, 220-110-285	Aquatic Habitat Guidelines white papers (WDFW)
Channel design features	Spawning pads; habitat enhancement; off-channel rearing and other ponds; large woody debris (LWD)- removal, repositioning, addition; channel changes and realignment; off-channel channels (new floodplain and high flow bypass); gradient control structures	220-110-080, 220-110-150, 220-110-180	Macro-Habitat Restoration Techniques, Aquatic Habitat Guidelines white papers, Siting and Design of Off-Channel Rearing Habitat (WDFW)
Mineral prospecting	Panning and high banking, sluicing and dredging	220-110-200 through 220-110-209	Gold and Fish pamphlet (WDFW)
Stormwater	Quantity, quality, outfalls and other instream structures	220-110-170	Ecology stormwater manual (1992)

generally provided at the county level, although more specific windows have been defined for some basins and subbasins.

In contrast, the work windows defined by biologists from the Services focus upon sensitive periods and the presence of listed fish species in watercourses. It is important that the BA report the in-water work window that has been approved by all three agencies (USFWS, NOAA Fisheries, and WDFW). This is the window that must be included in the special provisions. Any changes to the in-water work window proposed by the project must be approved by all three agencies.

14.4 Guidance for Effect Determinations Pertaining to In-Water Work

WSDOT has developed guidance for effect determinations related to in-water work activities. The following information is intended as guidance only and has not been uniformly accepted by the Services as providing adequate coverage for listed species or critical habitats. In addition, site-specific conditions largely determine the types and extent of impacts that will result from in-water work activities. As a result, there likely will be significant variation in the effect determinations generated for different projects.

Work conducted within the wetted channel of a riparian system or in marine waters can be expected to result in impacts on surrounding habitats and species in virtually every case. Consequently, the most common effect determinations for in-water work are *not likely to adversely affect* and *likely to adversely affect*. The effect determinations recommended below for in-water work are project-specific and may not apply to every project.

Determination of No Effect *for In-Water Work Projects*

Projects that include in-water work will have *no effect* on listed fish species if the following condition is met:

- Work occurs outside a WRIA with a listed fish evolutionarily significant unit (ESU) or distinct population segment (DPS), or in WRIAs containing no listed fish species.

Determination of May Affect but Is Not Likely to Adversely Affect *for In-Water Work Projects*

Projects that include in-water work *may affect but are not likely to adversely affect* listed fish species if the following conditions are met:

- For work below the OHWM to replace or extend culverts: no ESA-listed species are present in the system during the approved work window, and no spawning habitat will be disturbed.
- All work is conducted within the WDFW stipulated in-water work window (in accordance with the *Gold and Fish* rule or a hydraulic project approval [HPA] permit).
- All work occurs outside rearing and spawning areas.
- The project does not degrade the environmental baseline.

Determination of May Affect and Is Likely to Adversely Affect *for In-Water Work Projects*

Projects that include in-water work *may affect and are likely to adversely affect* listed fish species under the following conditions:

- The project requires work in water where residual chinook salmon or other rearing listed salmonids are present.
- The project requires moving or handling listed fish species.
- The project requires in-water work and has the potential for a direct *take* of listed species, including electrofishing or handling of listed fish.
- The project involves disturbance or filling of wetlands that are hydrologically connected (i.e., have a seasonal surface flow connection) to salmonid-bearing streams and provide rearing or refugia habitat for listed salmonids, whose habitat is in short supply in the watershed.
- The project requires blasting to remove slide material, and there is a high potential for materials to enter listed fish-bearing waters when listed fish are likely to be present.

Scheduling work within the WDFW-approved work window does not necessarily ensure that the proposed timing of the project will be accepted by the Services. The Service biologists and reviewers should be consulted prior to completion of a BA to ensure that optimal timing for in-water work is used.

In addition, there is some debate within the Services regarding how to adequately demonstrate any degradation of the environmental baseline in relation to a project action area. The project biologist should identify the environmental characteristics of the project action area and consider all possible effects upon those current conditions that may result from project activities. Whenever possible, effects of a proposed action should be qualitatively or quantitatively described to provide reviewers with a clear sense of the potential for project-related impacts to affect baseline conditions and the extent of those impacts.

If listed fish species are present in the project action area during construction, or if rearing or spawning habitat is present and will be damaged or affected by project activities, it is likely that in-water work will warrant a *likely to adversely affect* determination. In listed bull trout spawning subwatersheds, the presence of bull trout can be assumed year-round due to the variety of life history forms that exist.

The BA should include a minimization measure requiring that only personnel with fish experience may move the fish from an in-water work area.

14.5 WSDOT Fish Removal Protocols and Standards

Because in-water work often necessitates the exclusion or removal of fish from the project construction area, the WSDOT Fish Removal Protocols and Standards have been provided here as a reference.

14.5.1 Protocols and Standards

Federal resource agencies have expressed an interest in the Washington State Department of Transportation (WSDOT) developing a work area isolation/fish removal protocol for agency activities where fish removal may be necessary. The following protocol was developed in an attempt to standardize WSDOT's activities when they are required to remove fish from work areas. This protocol may not apply or may be modified in emergency situations or in certain areas that have unique site-specific characteristics.

Isolation of the work area, fish removal, and release of fish shall be conducted or directed by a biologist who possesses the competence to ensure the safe handling of all Endangered Species Act (ESA) listed fish, and who is also experienced with work area isolation.

- **Isolation of the Work Area:** Installation of block nets will occur at predetermined locations, based on site characteristics, to prevent fish and other aquatic wildlife from moving into the work area. When selecting a suitable site look for an area that has desirable attributes such as slower flows, suitable locations for stake and/or gravel bag placement. Whenever conditions allow, the downstream block net shall be placed first. The upstream block net shall then be used as a seine to herd fish from the downstream block net location upstream to the point selected for the upstream block net installation. If feasible, this action will potentially move significant numbers of fish upstream, out of the impact area prior to other removal methods. If herding fish upstream is prohibitive because of flow velocities, installation of the upstream block net first, then the herding of fish downstream and installing the downstream block net may be effective. Both approaches have the added benefit of relocating fish without physically handling them.

Block net mesh size, length, type of material, and depth will vary based on site conditions. The directing biologist on site will base the design of block nets on specific site characteristics such as water depth, velocity and channel width. Typical block net material is 9.5 millimeter stretched mesh. Block nets shall remain in place until in-water work is completed. Block nets will require leaf and debris removal. An individual should be assigned the responsibility of frequently checking the nets to maintain their effectiveness and integrity. The frequency of such checks will be determined on a case-by-case basis, dependent upon the system, season and weather conditions. An individual shall be stationed at the downstream block net continuously during electrofishing sessions, to recover stunned fish in the event they are washed downstream and pinned against the net. Block nets need to be secured along both banks and in-channel to prevent failure during unforeseen rain events or debris accumulation. Some locations may require additional block net support (examples include galvanized hardware cloth and metal fence posts).

- **Fish Removal:** The following methods provide alternatives for removal of fish from the area between the block nets. All other aquatic life encountered will also be released at an appropriate site. These methods are given in order of preference and for many locations a combination of methods will need to be applied. The use of visual observation techniques (e.g., snorkeling, surveying with polarized glasses or plexiglass bottomed buckets) should be considered for evaluation of removal method effectiveness and to identify specific locations of fish concentrations prior to removal attempts. Site specific project differences will determine the degree of aggressiveness in removal attempts. For instance, in areas where the streambed will be completely dewatered, highly aggressive techniques may be required to remove all fish and prevent death to individual fish due to suffocation and/or dessication. In contrast, large unconfined areas where isolation is impossible and in-water work is limited to a very specific area, total removal of fish is likely impossible and possibly not necessary due to the ability of fish to relocate and avoid disturbance and associated impacts. Fish shall not be sampled during removal activities as this protocol is intended to address fish removal not research. Fish species, number and an age class estimate will be the default information that is documented.

- **Use of a seine net shall be the preferred method.** The remaining methods shall be used when seining is not possible or to enhance the effectiveness of seining.

  - Seines made from 9.5 mm stretched nylon mesh shall be used to remove fish from the isolated stream reach. Seine design will be dependent upon site-specific characteristics. The on-site biologist will plan seining procedures based on an evaluation of site characteristics.

- On projects where dewatering will occur, aquatic life will be collected by hand or with dip nets as the site is slowly dewatered.

- Capture of fish by personnel in water or on shore using hand-held nets when in-water work will occur without dewatering (typically used in conjunction with seining).

- Baited minnow traps (typically used in conjunction with seining).

- Electrofishing shall be performed only when other methods have been determined to be unfeasible or ineffective by the directing biologist. Electrofishing studies document injury rates to fish even at low settings. Therefore, use of this method is discouraged when unnecessary. The potential for injury to ESA-listed fish may outweigh the benefit of capture and relocation of all fish present in the work area. Electrofishing research results reveal a trend that as number of vertebrae and spine length increase, injury potential also increases. Therefore, the following guidelines are for juvenile ESA-listed fish and **exclude adult ESA-listed fish.** Areas where redds are present shall not be exposed to electrofishing activity. Capture and removal of adult ESA-listed fish will have to be accomplished using an alternate method other than electrofishing if herding them out of the area to be isolated is not possible. The following conditions shall apply to use of electrofishing as a means of fish removal:

    - Electrofishing shall only be conducted when a biologist with at least 100 hours of electrofishing experience is on site to conduct or direct all activities associated with capture attempts. The directing biologist shall be familiar with the principles of electrofishing including the interrelated effects of voltage, pulse width and pulse rate on fish species and associated risk of injury/mortality. The directing biologist shall have knowledge regarding galvanotaxis, narcosis and tetany, their respective relationships to injury/mortality rates, and have the ability to recognize these responses when exhibited by fish.

    - The following chart shall be used as guidelines for electrofishing in water where the potential to encounter ESA-listed juvenile fish exists. Visual observation of the size classes of fish in the work area is helpful to avoid injury to larger fish by the mistaken assumption that they are not present.

	Initial Setting	Conductivity (μS/cm)	Maximum Settings
Voltage	100 V	< 100	1100 V
		100-300	800 V
		> 300	400 V
Pulse Width	500 μs		5 ms

- Seasonal timing restrictions for conducting electrofishing shall be dependent upon the river system, fish composition and an analysis of the life history of documented species. Spawning adults and redds with incubating eggs should not be subjected to the effects of electrofishing. As a general rule, anadromous waters should not be electrofished from October 15 to May 15 and resident waters from November 1 to May 15. It shall be the responsibility of the directing biologist to research and assess the time of year (for each river segment) when electrofishing is appropriate.

- Each session shall begin with low settings for pulse width and pulse rate. If fish present in the area being electrofished do not exhibit an appropriate response, the settings should be gradually increased until the appropriate response is achieved (galvanotaxis). Conducting electrofishing activity at the minimal effective settings is imperative because as pulse width and pulse rate increase, fish injury rates increase. Minimum effective voltage settings are dependent upon water conductivity and will need to increase as conductivity decreases. Higher voltages elevate the risk of serious injury to fish removal personnel. Use the lowest effective setting for pulse width, pulse rate and voltage to minimize personnel safety concerns and help minimize fish injury/mortality rates.

- The operator shall avoid allowing fish to come into contact with the anode. The zone of potential fish injury is 0.5 m from the anode. The directing biologist shall determine whether netting shall be attached to the anode. When site conditions allow use of an unnetted anode this method is preferred, due to the fact that this capture technique reduces mortality/injury rates. Techniques employed when using an unnetted anode keep fish farther from the anode and expose them to significantly less time in the zone of potential injury mentioned earlier. Extra care shall be taken near in-water structures, undercut banks, in shallow waters, or high-density fish areas. Voltage gradients may be abnormally intensified in these areas and fish are more likely to come into close contact with the anode. Consider lowering the voltage setting in shallow water sections. When electrofishing areas near undercut banks or where structures may provide cover for fish, use the anode to draw the fish out by placing the activated anode near the area fish are likely present and slowly draw the anode away. Fish experiencing galvanotaxis will be attracted to the anode and will swim away from the structure toward the anode so that they can be netted. This will not work on fish that experience narcosis or tetany. Therefore, fish response should be noted in adjacent areas prior to attempts made near structures. This should help avoid prolonged exposure of fish to the electrical field while in an immobilized state.

- Electrofishing shall be performed in a manner that minimizes harm to fish. Once an appropriate fish response (galvanotaxis) is noted, the stream segment shall be worked systematically, moving the anode continuously in a herringbone pattern through the water. Do not electrofish one area for an extended period of time. The number of passes shall be kept to a minimum, will be dependent upon site specific characteristics, and be at the discretion of the directing biologist. Adequate numbers of personnel shall be on-site to minimize the number of passes required for fish removal. Adequate staff to net, recover, and release fish in a prompt manner shall be present. Fish shall be removed from the electrical field immediately and recovered when necessary. Fish shall not be held in the net while continuing to capture additional fish.

- Carefully observe and document the condition of the captured fish. Dark bands on the body and extended recovery times are signs of injury or handling stress. When such signs are noted, the settings for the electrofishing unit and/or manner in which the electrofishing session is proceeding need adjustment. These characteristics may be an indication that electrofishing has become an inappropriate removal method for that specific site. Specimens shall be released immediately upstream of the block nets in an area that provides refuge. Each fish shall be capable of remaining upright and actively swimming prior to release (see FISH RELEASE section).

- Electrofishing shall not occur when turbidity reduces visibility to less than 0.5 meters and shall not occur when water temperature is above 18°C or below 4°C.

- If the water conductivity exceeds 350 μS/cm, electrofishing shall not occur.

    - Pumps used to temporarily bypass water around work sites shall be fitted with mesh screens to prevent aquatic life from entering the intake hose of the pump. The screen shall be installed as a precautionary measure to protect any fish and other wildlife, which may have been missed in the isolation and fish removal process. The screens will also prevent aquatic life from entering the intake hose if a block net should fail. Screens shall be placed approximately 2 to 4 feet from the end of the intake hose to assure fish are not pinned upon the screen. Screening techniques must be in compliance with Washington State Laws RCW 77.16.220, RCW 77.55.040, and RCW 77.55.070.

    - All fish shall be removed from stream crossing structures within the isolated stream reach. Connecting rod snakes may be used to help move fish out of the structure. The connecting rod snake is made of wood sections approximately 3 feet in length. When dewatering is to occur a seine may be placed at the downstream end of the crossing structure. As the water level goes down fish inside the culvert, in theory, will evacuate downstream into the seine that is in place at the outlet. The snake may be wiggled slowly through the pipe to encourage evacuation of fish out of the culvert. Other previously listed capture techniques shall be employed if required.

- **Fish Release:** For the period between capture and release, all captured aquatic life shall be immediately put into dark colored containers filled with clean stream water. Fish removal personnel shall provide: a healthy environment for the stressed fish; minimum holding periods; and low fish densities in holding containers to avoid effects of overcrowding. Large fish shall be kept separate from smaller prey-sized fish to avoid predation during containment. Water-to-water transfers shall occur whenever possible, and the use of sanctuary nets is encouraged. Frequent monitoring of holding container temperature and well being of the specimens will be done to assure that all specimens will be released unharmed. Potential shade areas for fish holding periods and supplemental oxygen shall be considered in designing fish handling operations.

Captured aquatic life will be released in an appropriate area, designated by the directing biologist, that provides cover and flow refuge. The release site(s) will be determined by the directing biologist and may be based on specific site characteristics (flow and cover) and type of fish captured (out migrating smolt, kelt, prespawn migrating adult, etc.). More than one site may be designated to provide for the varying migrational needs and to separate prey size fish from larger fish. The directing biologist shall consider fish migration requirements, size classes of fish, and duration of work area isolation when designing fish release plans. Each fish shall be capable of remaining upright and have the ability to actively swim upon release. One person shall be designated to transport specimens in a timely manner to the site selected for release. All ESA-listed dead fish shall be preserved and delivered to the pertinent regulatory agency. All work area isolation, fish removal, and fish release activity shall be thoroughly documented. Specifically, any injuries or mortalities to ESA-listed or proposed species shall be provided to National Marine Fisheries Service (NOAA fisheries) or United States Fish and Wildlife Service (USFWS), depending on which agency has jurisdiction over that species.

In-Water Work Fish Removal Monitoring Report

Start Date:
End Date:

Waterway:
County:

Construction Activities:

Number of fish observed:

Number of salmonid juveniles observed (include species):

Number of salmonid adults observed (include species):

What were fish observed doing prior to construction:

What did the fish do during and after construction:

Number of fish stranded as a result of this activity:

How long were the fish stranded before they were captured and released to flowing water:

Number of fish that were killed during this activity (include species):

Send Report to:

National Marine Fisheries Service
Washington State Habitat Branch
Attn: Transportation Team
510 Desmond Drive SE, Suite 103
Lacey, WA 98503

15.0 Performance-Based, Batched, and Programmatic Biological Assessments

15.0 Performance-Based, Batched, and Programmatic Biological Assessments

Chapter Summary

- Performance-based biological assessments (BAs) and biological evaluations (BEs) are often written early in the design phase of a project. Because detailed information on the project description and design is lacking at that early stage, these reports are general in nature and are intended to provide safeguards for habitat and species by defining actions that will not be included in the project or impacts that will be avoided.

- Batched BAs and programmatic BAs or BEs provide collective coverage for groups of projects.

- Batched BAs can be grouped by project type or by geographic location.

- Programmatic BAs and programmatic BEs typically are written to cover several project types with NE, NLTAA, and LTAA determinations focusing on either: 1) a finite period of time (defined in the programmatic BA), 2) a defined geographic area, or 3) a particular species.

- Programmatic BAs and BEs establish conditions allowing specific activities that occur within general programs to proceed without individual concurrence from the Services for each project, provided that the project meets the requirements of the programmatic BA or BE.

- The U.S. Army Corps of Engineers has three programmatic BEs available for public use

  - One Corps of Engineers programmatic BE addresses the following activities statewide:

    - Aids to navigation
    - Mooring buoys
    - Temporary recreational structures (not approved for listed salmon and steelhead)
    - Replacement of up to 18 existing pilings
    - Installation or replacement of one boatlift
    - Installation of scientific measurement devices
    - Oil spill containment

  - Fish and wildlife harvesting
  - Tideland markers
  - Near-shore fill for state hydraulic project approval mitigation requirements
  - Minor bank stabilization repair activities.

- The second Corps of Engineers programmatic BE addresses the following activities statewide:
  - Stream crossings by roads, levees, dikes, or similar features
  - Tide gates
  - Certain types of debris jams
  - Certain types of sediment bars or terraces.

- The third Corps of Engineers programmatic BE addresses the following activities in the lower Columbia River:
  - Maintenance dredging
  - Minor discharges and excavation
  - Overwater and in-water structures
  - Return water from upland disposal sites
  - Road construction repairs and improvements
  - Stream and wetland restoration
  - Stream bank protection
  - Surveying, construction, operation, and maintenance
  - Utility lines
  - Water control structures.

This chapter provides a general overview of performance-based BAs, batched BAs, and programmatic BAs and BEs, and identifies potential information sources for learning more about them. This chapter also discusses the three existing Corps of Engineers programmatic BEs.

PART 3 of this manual introduces WSDOT biologists to the programmatic BAs developed by WSDOT and provides instruction on how to use them.

15.1 General Considerations

Any major construction project with a federal nexus (defined as receiving federal funding, requiring federal permits, or taking place on federal lands) is required under the Endangered Species Act to submit a BA to evaluate the impact of the project on listed species. This in turn requires consultation with the Services.

The process of producing a BA and receiving concurrence from the Services can take from one month to one year, depending upon the complexity of the proposed project. The Services and many action agencies have been working to streamline this process. These entities increasingly have been developing BAs early in the design process, in some cases, performance-based BAs.

The Services and action agencies also have been developing BAs that provide coverage for multiple projects within a single encompassing report. These documents, called batched BAs and programmatic biological assessments or biological evaluations, provide collective coverage for groups of projects of several types:

- Specific projects of a similar type (batched BA)
- Specific projects that take place in a similar region (batched BA)
- General programs of activities rather than individual projects (programmatic BA or BE).

15.1.1 Performance-Based Biological Assessments

Occasionally, BAs must be developed early in the design phase of a project in order to support the National Environmental Policy Act (NEPA) process. NEPA EIS documents cannot be signed and adopted until the ESA Section 7 consultation process has been completed. Performance-based BAs are usually written for large, complex projects requiring years to complete project designs and secure all necessary permits.

A performance-based BA is often written before there is a detailed description of the proposed action or even before an alternative is chosen. In order to develop effect determinations that can be supported, these BAs must establish safeguards for habitat and species that will be implemented by the project. These safeguards often outline activities that will *not* be included in a project (e.g., the project will not entail in-water work, will not disturb riparian vegetation, will not fill wetlands, or will avoid placing bridge elements below the OHWM). Often these BAs place limitations on the scope of the project and project impacts (e.g., the bridge will span the entire floodplain; the project will be completed within one construction season; or no more than one acre of vegetation will be removed). Lacking a clear project description, a performance-based BA defines the project by specifying activities and elements that are not included or allowed in the project.

Because these BAs are written prior to completing project designs, often consultation must be reinitiated after the scope of the project has been more clearly defined. Reinitiation in this case allows for a more detailed and thorough analysis of effects based upon current or final project designs.

15.1.2 Batched Biological Assessments

Projects can be grouped by project type (e.g., pavers or bridge scour repair) or by geographic location (e.g., projects within a single watershed). General impacts are identified, discussed, and evaluated in the batched BA, and minimization measures are developed to minimize these common impacts. Site-specific impacts are discussed as necessary in relation to the projects. WSDOT has successfully used batched BAs to address paving projects.

15.1.3 Programmatic Biological Assessments and Biological Evaluations

Programmatic BAs and BEs typically are written to cover several project types with NE, NLTAA, and LTAA calls, either within a defined geographic area, over a limited period of time, or for a particular species (as defined in the programmatic BA). The programmatic BA may be approved by one or both of the Services.

Programmatic BAs group together projects within specific programs (e.g., several activities that fall under the safety improvement program [such as guardrail work, traffic signal installation or replacement, slope flattening, or tree removal from the clear zone] or the environmental retrofit and restoration program [such as culvert replacement, stormwater treatment facility installation, correction of fish barriers, or installation of large woody debris]). Specific effect determination criteria are identified for each species addressed in the programmatic BA. Projects that cannot meet the criteria defined in the programmatic BA may require an individual BA for review and concurrence by the Services.

A project biologist reviews each individual project to determine whether it meets the requirements outlined in the programmatic BA. If a project meets those requirements, the project evaluation or assessment is documented through the use of a programmatic BA form or an abbreviated BA report, which is sent to the Services. In most cases, projects complete their Section 7 requirements through the programmatic BA, so that individual concurrence from the Services is not required.

The process used for consultation and to document and track projects receiving coverage under a programmatic BA may differ slightly among programmatic BAs. For each programmatic BA, a form or an abbreviated BA template is provided to facilitate ongoing documentation of the projects covered under that programmatic BA. This template is filled out by the action agency in coordination with the Services.

In 2000, the Corps of Engineers completed a programmatic consultation to address many minor construction activities that it implements directly or for which it issues permits (*Phase I Programmatic Biological Evaluation for the State of Washington for Salmonid Species Listed or*

Proposed by the National Marine Fisheries Service and the U.S. Fish and Wildlife Service under the Endangered Species Act). This consultation was subsequently revised in May 2001. The activity types covered by this programmatic consultation are considered *not likely to adversely affect* (NLTAA).

The Corps developed a second programmatic consultation in 2001 (and revised it in July 2002) for removal of fish passage barriers (*Phase II Programmatic Biological Evaluation for Habitat Restoration/Rehabilitation Activities in the State of Washington for Species Listed or Proposed by National Marine Fisheries Service and U.S. Fish and Wildlife Service under the Endangered Species Act*). The activity types covered by this programmatic consultation are considered *likely to adversely affect* (LTAA).

A third programmatic consultation was completed by the Corps in July 2003 to address activities in the main stem of the lower Columbia River below McNary dam that potentially affect fish species under NOAA Fisheries jurisdiction.

WSDOT has developed programmatic BAs for internal use by WSDOT biologists. One WSDOT programmatic BA, that is still in use, addresses species in eastern Washington that are under USFWS jurisdiction (*Programmatic Biological Assessment for Eastern Washington Regions*). This programmatic BA applies only to a selection of WSDOT *no effect*, *not likely to adversely affect*, and *likely to adversely affect* projects.

WSDOT programmatic BAs are intended for use only by WSDOT biologists and are not available for use outside WSDOT.

15.1.4 Information Sources

The programmatic consultations the Corps has completed, as well as information on the required timing windows specified in these programmatic documents, are available online at <http://www.nws.usace.army.mil/PublicMenu/Menu.cfm?sitename=REG&pagename=Programmatics>.

Guidance provided by USFWS for transportation agencies developing programmatic strategies is available on the USFWS website or on the compact disc accompanying this manual. Also provided on this website is an outline of the general process for developing programmatic BAs (<http://endangered.fws.gov/consultations/DOT-guidance.html>).

15.2 U.S. Army Corps of Engineers Programmatic Biological Evaluations

15.2.1 Phase I Programmatic Biological Evaluation for the State of Washington for Salmonid Species Listed or Proposed by the National Marine Fisheries Service and the U.S. Fish and Wildlife Service Under the Endangered Species Act

The Corps of Engineers produced this programmatic BE for portions of its nationwide and regional permit programs (revised May 30, 2001), to provide coverage to all of Washington state. The programmatic BE received concurrence from NOAA Fisheries on November 9, 2000, and received concurrence from USFWS (for western Washington only) on October 27, 2000. Three management areas are defined in the programmatic BE:

- All freshwater areas excluding the Columbia River main stem
- The Columbia River main stem, including the Snake River and Baker Bay
- Marine and estuarine waters, excluding Baker Bay.

This programmatic BE can be applied to actions covered under certain nationwide permits or regional general permits that the Corps believes merit a determination of NLTAA for fish species or designated critical habitat. Specific projects include the following:

- Aids to navigation
- Mooring buoys
- Temporary recreational structures (not approved for listed salmon and steelhead populations)
- Replacement of up to 18 existing pilings
- Installation or replacement of one boat lift
- Installation of scientific measurement devices
- Oil spill containment
- Fish and wildlife harvesting
- Tideland markers
- Near-shore fill for state hydraulic project approval mitigation requirements
- Minor bank stabilization repair activities.

The descriptions and conditions for the activities covered under the programmatic consultation are separated into the geographic regions or management areas described above. The conditions for each activity may vary by region, or the activity may not be approved in certain regions. Regions are separated by water body type and by county. Additionally, all activities must comply with the general implementation conditions and timing windows of the programmatic consultations.

15.2.2 Phase II Programmatic Biological Evaluation for Habitat Restoration / Rehabilitation Activities in the State of Washington for Species Listed or Proposed by National Marine Fisheries Service and U.S. Fish and Wildlife Service under the Endangered Species Act

This programmatic BE (April 13, 2001; revised July 29, 2002) addresses the removal of fish passage barriers. NOAA Fisheries issued a biological opinion pertaining to this programmatic BE on October 29, 2001. USFWS issued a biological opinion on May 29, 2002. The activities covered under this programmatic consultation include removal of the following potential barriers:

- Stream crossings by roads, levees, dikes, or similar features
- Tide gates
- Certain types of debris jams
- Certain types of sediment bars or terraces.

Unlike the Phase I programmatic BE, this document also covers nonsalmonid listed species under the jurisdiction of NOAA Fisheries and the USFWS. Similar to the limitations described for the Phase I programmatic BE, projects that use the Phase II programmatic BE must meet the requirements and approved windows stipulated in the document.

15.2.3 Programmatic Consultation for the Lower Columbia River

This programmatic BE addresses activities in the main stem of the lower Columbia River below McNary dam that potentially affect fish species under NOAA Fisheries jurisdiction (biological opinion issued July 8, 2003). This programmatic BE applies only to federally listed fish species (and designated critical habitat or essential fish habitat) under the jurisdiction of NOAA Fisheries (November 30, 2004). The activities covered under this programmatic BE include the following:

- Site preparation
- Minor discharges and excavation
- Over-water and in-water structures
- Road construction repairs and improvements

- Stream and wetland restoration
- Stream bank protection
- Utility lines
- Water control structures.

To be covered by this programmatic BE, projects must meet the descriptions and conditions for the work activity, must comply with all applicable terms and conditions, and must be conducted during the approved work window.

15.3 WSDOT Programmatic Biological Assessments

WSDOT programmatic BAs are intended for use only by WSDOT biologists and are not available for use outside WSDOT.

16.0 Essential Fish Habitat

16.0 Essential Fish Habitat

Chapter Summary

- Three federal fishery management plans and their associated *essential fish habitat* (EFH) are applicable to projects within Washington state: the Pacific coast ground-fish fishery, the coastal pelagic species fishery, and the Pacific coast salmon fishery.
- The ground-fish fishery includes 83 species.
- The coastal pelagic fishery includes four fin fishes (Pacific sardine, Pacific [chub] mackerel, northern anchovy, and jack mackerel) and the invertebrate market squid.
- The Pacific salmon fishery includes chinook, coho, and Puget Sound pink salmon.
- If the federal action agency determines that an action or proposed action may have an adverse effect on essential fish habitat, consultation is required.
- If the federal action agency determines that an action or proposed action will not have an adverse effect on essential fish habitat, consultation is not required.
- In an essential fish habitat assessment, the federal action agency provides to NOAA Fisheries a description of the proposed action, an analysis of effects, minimization measures or proposed mitigation that will be incorporated into the project to minimize potential adverse effects on essential fish habitat, and an effect determination.
- If the essential fish habitat assessment is packaged with the BA, it should be a self-contained document included in the appendices of the BA.
- Rather than repeating information provided in the BA, the essential fish habitat assessment can cross-reference relevant sections in the BA that analyze potential project impacts on species or critical habitat.
- Discussion of project effects on essential fish habitat should be general and should be based on the habitat rather than each species.
- Effect determinations should be made for each group of species rather than for each species.

This chapter provides general information on essential fish habitat and the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), including information pertaining to each of the three federally managed fisheries and their associated essential fish habitat located in Washington state, an overview of the consultation process, guidance for analyzing effects on essential fish habitat, guidance for effect determinations, recommendations for content and language (provided by WSDOT), and a template for essential fish habitat assessments.

16.1 Statutory Protection of Essential Fish Habitat

The Magnuson-Stevens Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267) requires federal agencies to consult with NOAA Fisheries on activities that may adversely affect essential fish habitat. In addition, the law requires fishery management councils to include descriptions of essential fish habitat and potential threats to essential fish habitat in all federal fishery management plans.

Essential fish habitat is defined in the Magnuson-Stevens Act as *those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity*. The law provides the following additional definitions for clarification:

- “Waters” include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate.
- “Substrate” includes sediment, hard bottom, structures underlying the waters, and associated biological communities.
- “Necessary” means the habitat required to support a sustainable fishery and the managed species contribution to a healthy ecosystem.
- “Spawning, breeding, feeding, or growth to maturity” covers the full life cycle of a species.

Three federal fishery management plans and their associated essential fish habitat are applicable to projects and activities within Washington state: the Pacific coast ground fish fishery, the coastal pelagic species fishery, and the Pacific coast salmon fishery. The ground fish fishery includes 83 species; the coastal pelagic fishery includes four fin fishes (Pacific sardine, Pacific [chub] mackerel, northern anchovy, and jack mackerel) and the invertebrate market squid; and the salmon fishery includes chinook, coho, and Puget Sound pink salmon.

The University of California at San Diego sponsors an excellent online source of information for essential fish habitat issues: <http://swr.ucsd.edu/efh.htm>. The NOAA Fisheries website is also useful: <http://www.nwr.noaa.gov/Salmon-Habitat/Essential-Fish-Habitat/Index.cfm>.

16.1.1 Pacific Ground Fishes

Research on the life histories and habitats of these species varies in completeness. While some species are well studied, there is relatively little information on certain other species. Information about the habitats and life histories of the species managed by the Pacific coast ground-fish fishery management plan is evolving, with varying degrees of improvement in information for each species.

At present, the fishery management plan includes a description of a limited number of composite essential fish habitats for all Pacific coast ground fish species. The seven composite essential fish habitat identifications are described below:

- **Estuarine—**Those waters, substrates, and associated biological communities within bays and estuaries of the coasts of Washington, Oregon, and California seaward from the high tide line or extent of upriver saltwater intrusion. These are delineated from the USFWS National Wetlands Inventory and supplemented from the NOAA Coastal Assessment Framework for the water portion of the estuarine drainage areas for two small estuaries (Klamath River and Rogue River), the Columbia River, and San Francisco Bay.
- **Rocky shelf—**Those waters, substrates, and associated biological communities living on or within 10 meters (5.5 fathoms) overlying the rocky areas, including reefs, pinnacles, boulders, and cobble along the continental shelf, excluding canyons, from the high tide line to the shelf break (approximately 200 meters, or 109 fathoms).
- **Non-rocky shelf—**Those waters, substrates, and associated biological communities living on or within 10 meters (5.5 fathoms) overlying the substrates of the continental shelf, excluding the rocky shelf and canyon composites, from the high tide line to the shelf break (approximately 200 meters, or 109 fathoms).
- **Canyon—**Those waters, substrates, and associated biological communities living within submarine canyons, including the walls, beds, seafloor, and any outcrops or landslide morphology such as slump scarps and debris fields.
- **Continental slope/basin—**Those waters, substrates, and biological communities living on or within 20 meters (11 fathoms) overlying the substrates of the continental slope and basin below the shelf break (approximately 200 meters, or 109 fathoms) and extending to the westward boundary of the *exclusive economic zone*.
- **Neritic zone—**Those waters, substrates, and biological communities living in the water column more than 10 meters (5.5 fathoms) above the continental shelf.

- **Oceanic zone—**Those waters and biological communities living in the water column more than 20 meters (11 fathoms) above the continental slope and abyssal plain, extending to the westward boundary of the exclusive economic zone.

16.1.2 Coastal Pelagic Species

The coastal pelagic species fin fishes generally occur above the thermocline in the upper mixed layer and are therefore considered pelagic (occurring in the water column near the surface and not associated with substrate). For the purposes of essential fish habitat, the four fin fishes (Pacific sardine, Pacific [chub] mackerel, northern anchovy, and jack mackerel) are treated as a single species complex because of the similarities in their life history and habitat requirements. Market squid are also treated in this same complex because they are also fished above spawning aggregations.

16.1.3 Pacific Salmon

U.S. Geological Survey (USGS) hydrologic units are used as the descriptor of essential fish habitat. The EFH for the Pacific coast salmon fishery is defined as those waters and substrate necessary for salmon production needed to support a long-term sustainable salmon fishery and salmon contributions to a healthy ecosystem. To achieve that level of production, EFH must include all those streams, lakes, ponds, wetlands, and other currently viable water bodies and most of the habitat historically accessible to salmon in Washington, Oregon, Idaho, and California. This does not include habitats above the impassible barriers identified by the Pacific Fishery Management Council Fishery Management Plan (PFMC 1999).

In the estuarine and marine areas, salmon EFH extends from the near-shore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone (370.4 km) offshore of Washington, Oregon, and California north of Point Conception.

Foreign waters off Canada, while still salmon habitat, are not included in salmon EFH because they are outside United States jurisdiction. The Pacific coast salmon fishery also includes the marine areas off Alaska designated as salmon EFH by the North Pacific Fishery Management Council. This identification of EFH is based on the habitat used by coho, chinook, and pink salmon.

16.2 Essential Fish Habitat Consultation

Essential fish habitat consultations address species in the federally managed Pacific ground-fish fishery, the coastal pelagic species fishery, and the Pacific salmon fishery. If the federal action agency determines that an action or proposed action may have an adverse effect on EFH, consultation is required. If the federal action agency determines that an action or proposed action will not have an adverse effect on EFH, consultation is not required.

Usually, but not always, when impacts of a proposed action affect species under NOAA Fisheries jurisdiction, EFH species or EFH itself also will sustain impacts from the proposed action. Consequently, the analysis of effects on EFH can often cross-reference the effects analysis provided within the BA for NOAA Fisheries species and critical habitat protected under the Endangered Species Act.

In some situations a separate EFH impact analysis may be required (e.g., cases in which a project does not affect the evolutionarily significant unit of a listed species, but is located where chinook, pink, or coho salmon or ground fishes occur). In another example, a separate analysis is appropriate when a BA only addresses impacts on bull trout and bull trout habitat, requiring additional analysis of potential impacts on coho, chinook, and pink salmon habitats, as well as habitat for ground fish or coastal pelagic species, in order to adequately address essential fish habitat.

There are four components of an essential fish habitat consultation:

- **Notification—**the federal action agency notifies NOAA Fisheries of an activity that may adversely affect EFH.
- **Essential fish habitat assessment—**the federal action agency provides NOAA Fisheries with a description of the proposed action, analysis of effects, and effect determination.
- **Conservation recommendations—**NOAA Fisheries involves the federal action agency in development of advisory EFH conservation recommendations and provides them to the federal agency.
- **Federal action agency response—**the federal action agency provides a written response to NOAA Fisheries within 30 days after receiving NOAA Fisheries conservation recommendations.

If the determination is that the proposed action may have an adverse effect on essential fish habitat, NOAA Fisheries must provide EFH conservation recommendations to the federal action agency that submitted the environmental documentation. The federal action agency must then provide a detailed written response within 30 days of receiving the recommendations (or at least 10 days prior to final approval of the action, if a decision by the federal action agency is required in less than 30 days).

The written response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. If the response is inconsistent with the recommendations made by NOAA Fisheries, adequate justification for not following the recommendations by NOAA Fisheries must be provided.

16.3 Analysis of Effects: Magnuson-Stevens Act and Essential Fish Habitat

To streamline the essential fish habitat consultation process, consultation can occur under NEPA, ESA, or another federal process agreed upon by NOAA Fisheries and the federal action agency. FHWA-funded projects may be streamlined by combining the EFH analysis with ESA Section 7 consultation. The analysis of project impacts on EFH should be prepared as a separate assessment document, to be included as an appendix to the BA.

Since the BA contains a detailed analysis of project impacts on critical habitat and the environmental baseline, it may already address most requirements of the EFH impact analysis. The adverse effects analysis discussed in the portion of the BA or BE addressing ESA requirements can be referenced in the EFH section of the document to avoid repetition.

In addition, it is not necessary to discuss the adverse effects on EFH on a species-by-species basis, as this would also be repetitive and would provide the reviewer with no additional information. Instead, the project's effects on EFH should be discussed more generally. If the minimization measures discussed in the ESA portion of the document will also minimize the potential adverse effects on EFH the project biologist may refer to that earlier description.

In general, the EFH appendix is not expected to exceed one page in length if other sections of the BA are referenced. However, if independent EFH analyses are required to address habitats not addressed in the BA, the appendix may be somewhat longer.

The objective of an EFH assessment is to determine whether the proposed action may adversely affect or will not adversely affect designated EFH for relevant federally managed commercial fishery species within the project action area. Therefore, the appropriate determination is either *may adversely affect* or *will not adversely effect*. There is no *may affect, not likely to adversely affect* category for EFH as there is under ESA.

If the designated EFH is for the Pacific coast salmon fishery, one effect determination must be made for Pacific salmon EFH. In instances where effects on an individual species are unique, an effect determination may be made for the EFH of a specific species (coho, chinook, or Puget Sound pink). If the EFH in the project area is associated with a ground fish or coastal pelagic species, an effect determination for EFH may be made for each of these species groups.

The analysis must also describe minimization measures proposed to avoid, minimize, or otherwise offset potential adverse effects on designated EFH resulting from a proposed action. The actual EFH discussed depends upon the project location and the species potentially present. Unless it is clear that the effects on a particular species are unique, it is not advisable to discuss the adverse effects on a species-by-species basis. Discussion of project effects on EFH should be general and based on the habitat rather than each species.

The following information should be provided in an essential fish habitat assessment:

- Action agency title
- Project name
- Background information on the Magnuson-Stevens Act and definition of essential fish habitat
- Description of the proposed activity
- A definition of the essential fish habitat designation for the fisheries potentially affected by the project
- An identification of the fisheries species likely to occur in the project area and a brief description of their use of the project action area (significant prey species [e.g., Pacific sand lance] should also be considered)
- Description of individual and cumulative adverse effects (and beneficial effects, if any) of the proposed project on relevant EFH, the managed species (including affected life history stages), and associated species such as major prey species
- Description of EFH minimization measures or proposed mitigation incorporated into the project to minimize potential adverse effects on EFH (additional conservation recommendations may be developed by NOAA Fisheries upon review of the assessment)
- Conclusion and a summary of potential effects on EFH taking into account the minimization measures stipulated in the previous section
- References to information sources that are specific to the EFH analysis, including information regarding the EFH-specific species occurring in the project action area and the descriptions and definitions of EFH used by the project biologist in the assessment (some of the most frequently used references are provided in the EFH assessment template at the end of this chapter).

The general essential fish habitat consultation and assessment process is similar to the consultation and assessment performed for ESA-regulated species and habitats, as illustrated at the end of this chapter in the detailed EFH assessment template. Additional information on west coast ground fishes is provided in the *EFH Excerpt from Amendment 11—Groundfish Fishery Management Plan*, which is provided on the compact disc accompanying this manual.

Additional information on EFH consultation can be found online at <http://www.nwr.noaa.gov/Salmon-Habitat/Essential-Fish-Habitat/Index.cfm>.

16.4 Guidance for Essential Fish Habitat Effect Determinations

Detailed guidance on essential fish habitat effects analysis is provided on the NOAA Fisheries website: <http://www.nwr.noaa.gov/Salmon-Habitat/Essential-Fish-Habitat/Index.cfm>.

A separate effect determination must be made for the essential fish habitat of each fishery (species group) that occurs in the project area. Hence a single report may contain an effect determination for several different kinds of EFH; one for Pacific coast salmonids, one for ground fishes, and one for coastal pelagic species.

16.5 Essential Fish Habitat Analysis Language

Essential fish habitat applies to several species that are not listed under the Endangered Species Act. Therefore, unlisted species may need to be addressed in the analysis of EFH impacts.

The example below contains recommended content and language for an analysis of EFH concerning species under NOAA Fisheries jurisdiction.

> **Recommended content for essential fish habitat analysis (to be provided in BA appendix):**
> Describe the law protecting essential fish habitat, how EFH is defined, the species considered under EFH, the occurrence of EFH within the project action area, and any impacts likely to affect EFH from the project activities. Habitat of prey species for the species considered under EFH should also be addressed. The impact analysis should not be lengthy if ESA-listed fishes are addressed in the BA, because most potential impacts on EFH should be addressed in this prior analysis. A determination of *may adversely effect* should be made if the action results in the reduction of quantity or quality of EFH. Otherwise, a determination of *will not adversely effect* or *no adverse effect* is appropriate.
>
> **Sample language for essential fish habitat analysis (to be provided in BA appendix):**
> The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) includes a mandate that NOAA Fisheries must identify essential fish habitat (EFH) for federally managed marine fishes, and federal agencies must consult with NOAA Fisheries on all activities or proposed activities authorized, funded, or undertaken by the agency that may adversely affect EFH. The Pacific Fisheries Management Council (PFMC) has designated EFH for the Pacific salmon fishery, federally managed ground fishes, and coastal pelagic fisheries (NOAA Fisheries 1999; PFMC 1999).
>
> The EFH designation for the Pacific salmon fishery includes all those streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except above the impassible barriers identified by PFMC (1999). In estuarine and marine areas, proposed designated EFH for salmon extends from near-shore

and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone offshore of Washington, Oregon, and California north of Point Conception (PFMC 1999).

The Pacific salmon management unit includes chinook (*Oncorhynchus tshawytscha*), coho (*Oncorhynchus kisutch*), and pink salmon (*Oncorhynchus gorbuscha*). All three of these species use Hood Canal for adult migration, juvenile out-migration, and rearing where suitable habitat is present. Coho and chinook are known to stage in Hood Canal as subadults.

The EFH designation for ground fishes and coastal pelagics is defined as those waters and substrate necessary to ensure the production needed to support a long-term sustainable fishery. The marine extent of ground fish and coastal pelagic EFH includes those waters from the near-shore and tidal submerged environment within Washington, Oregon, and California state territorial waters out to the exclusive economic zone (370.4 km [231.5 miles]) offshore between Canada and the Mexican border.

The west coast ground fish management unit includes 83 species that typically live on or near the bottom of the ocean. Species groups include skates and sharks, rockfishes (55 species), flatfishes (12 species) and ground fishes. Ground fishes such as lingcod (*Ophiodon elongates*), Cabezon (*Scorpaenichthys marmoratus*), and brown rockfish (*Sebastes auriculatus*) potentially occur in Hood Canal (NOAA Fisheries 1998). Coastal pelagics are schooling fishes, not associated with the ocean bottom, that migrate in coastal waters. West coast pelagics include the pacific sardine (*Sardinops sagax*), Pacific chub *(Scomber japonicus*), northern anchovy (*Engraulis mordax*), jack mackerel (*Trachurus symmetricus*), and market squid (*Loligo opalescens*). These fishes are primarily associated with the open ocean and coastal areas (PFMC 1998) and are not likely to occur in the project area.

The Pacific sand lance (*Ammodytes hexapterus*) is an important forage fish for juvenile chinook salmon. Loss of prey is considered an adverse effect on EFH. The Pacific sand lance is known to breed in Hood Canal.

Essential fish habitat for ground fishes and Pacific salmon is present in the project action area. The project will result in a minor, temporary effect on water quality. No permanent adverse effects on EFH for ground fishes, coastal pelagics, Pacific salmonids, or their prey species will result from the geotechnical test drilling. Therefore, the project will not adversely affect EFH for ground fishes, coastal pelagics, or Pacific salmonids.

16.6 Essential Fish Habitat Assessment Template

This template is intended to aid in the preparation of essential fish habitat assessments, which must contain the following information (see 50 CFR 600.920(g)):

- A description of the proposed project

- An analysis of the effects (including cumulative effects) of the proposed action on essential fish habitat and the managed species and associated species, such as major prey species, including affected life history stages

- The federal agency's views regarding the effects of the action on essential fish habitat

- Proposed mitigation, if applicable.

The essential fish habitat assessment template is available online at <http://www.nwr.noaa.gov/Salmon-Habitat/Essential-Fish-Habitat/Index.cfm>.

This template is intended as a guide in preparing an essential fish habitat assessment and can be modified as the writer sees fit. The text in italics is explanatory and should be removed from the final product.

If the essential fish habitat assessment accompanies a biological assessment or biological evaluation that will be provided to NOAA Fisheries, the information already supplied in the BA or BE can be referenced and need not be repeated in the EFH assessment. Headings that do not provide the information required by the EFH regulations, such as Action Agency and Project Name (which are already identified in the BA) need not be repeated in the EFH assessment appendix.

Essential Fish Habitat Assessment for
[project name and location]

Action Agency*: [name of project proponent]*

Project Name: *[project name and location]*

Essential Fish Habitat Background

The Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), requires federal agencies to consult with NOAA Fisheries on activities that may adversely affect essential fish habitat (EFH).

The objective of this EFH assessment is to determine whether or not the proposed action(s) "may adversely affect" designated EFH for relevant commercially, federally-managed fisheries species within the proposed action area. It also describes conservation measures proposed to avoid, minimize, or otherwise offset potential adverse effects to designated EFH resulting from the proposed action.

Description of the Proposed Action

Describe the project, or reference the description presented in previous sections of the BA. If a previous section is referenced, briefly describe the project in one *or two lines. The species and life-history stages affected should be noted here. They can be listed in table form (see Table 16-1). This table was constructed using the references at the end of the template.*

Potential Adverse Effects of Proposed Project

The specific essential fish habitat discussed depends on the project location and the species present. The adverse effects discussed in the BA or BE can be referenced, and additional effects can be discussed here. Unless it is clear that the effects on an individual species are unique, it is not necessary to discuss the adverse effects on a species-by-species basis, as this would certainly be repetitive and would provide no additional information. Instead, discuss the project's effects on EFH generally. However you should discuss the effects to salmonid, groundfish, and coastal pelagic EFH separately.

Adverse Effects on Essential Fish Habitat for Salmonids

Describe project effects on salmonid EFH.

Adverse Effects on Essential Fish Habitat for Ground Fishes

Describe project effects on ground fish EFH.

Adverse Effects on Essential Fish Habitat for Coastal Pelagic Species

Describe project effects on coastal pelagic EFH.

Essential Fish Habitat Conservation Measures

Describe the conservation measures incorporated into the project to minimize potential adverse effects on EFH. If these measures have already been described, refer to that description. An example follows:

The following measures will be implemented to minimize the potential adverse effects on designated EFH described above:

- Conservation measure 1
- Conservation measure 2
- etc.

Conclusion and Effect Determination

Summarize the potential effect that the project will have on EFH. This takes into account the conservation measures proposed as part of the project that were described above. [A determination of *may adversely effect* should be made if the action results in the reduction of quantity or quality of EFH. Otherwise, a determination of *will not adversely effect* or *no adverse effect* is appropriate.]

Table 16-1. Fish species and life-stages with designated essential fish habitat in the action area.

Ground Fish Species	Eggs	Larvae	Young Juvenile	Juvenile	Adult	Spawning
Spiny dogfish			X	X	X	
Ratfish				X	X	
Lingcod		X		X	X	X
Cabezon		X				
Kelp greenling		X				
Pacific cod		X	X	X	X	X
Pacific whiting (hake)			X	X	X	
Sablefish		X	X	X	X	X
Darkblotched rockfish				X	X	
Greenstriped rockfish				X	X	
Thornyhead		X				
Pacific Ocean perch				X	X	
Widow rockfish			X	X		
Miscellaneous rockfish				X	X	
Arrowtooth flounder				X	X	
Butter sole	X	X				
Curlfin sole	X					
Dover sole	X			X	X	
English sole	X	X	X	X	X	X
Flathead sole		X		X	X	X
Pacific sanddab				X	X	
Petrale sole			X	X	X	
Rex sole	X	X		X	X	
Sand sole	X	X				
Starry flounder	X	X	X			X
Northern anchovy	X	X		X	X	
Pacific sardine	X	X		X	X	
Pacific mackerel	X	X		X	X	
Jack mackerel					X	
Market squid	?	?	?		X	?
Salmon						
Coho salmon				X	X	
Chinook salmon			X	X	X	

Essential Fish Habitat References

Listed below for convenience are the references containing the descriptions and definitions of essential fish habitat, provided by NOAA Fisheries and the Pacific Fisheries Management Council. The specific references to be cited in each *project EFH assessment depend on the fishery groups (ground fishes, coastal pelagics, and salmonids) present in the project action area.*

Casillas, E., L. Crockett, Y. deReynier, J. Glock, M. Helvey, B. Meyer, C. Schmitt, M. Yoklavich, A. Bailey, B. Chao, B. Johnson, and T. Pepperell. 1998. Essential Fish Habitat, West Coast Groundfish—Appendix. National Marine Fisheries Service. 778 pp.

PFMC. 1998a. The Coastal Pelagic Species Fishery Management Plan: Amendment 8. Pacific Fishery Management Council.

PFMC. 1998b. Final Environmental Assessment/Regulatory Review for Amendment 11 to the Pacific Coast Groundfish Fishery Management Plan. Pacific Fishery Management Council.

PFMC. 1999. Amendment 14 to the Pacific Coast Salmon Plan. Appendix A: Description and Identification of Essential Fish Habitat, Adverse Impacts, and Recommended Conservation Measures for Salmon. Pacific Fishery Management Council.

17.0 Stormwater BMP Impact Assessment

17.0 Stormwater Impact Assessment

Chapter Summary

As part of a biological assessment, WSDOT assesses the environmental effects of stormwater and the construction of stormwater best management practices (BMPs) on the project site. This chapter provides guidance to determine and quantify these effects.

- Impacts resulting from stormwater and installation and operation of stormwater BMPs should be assessed for every project that is undergoing a Section 7 consultation under the ESA and that is subject to requirements of the *Highway Runoff Manual* (and therefore subject to evaluation of impacts resulting from the required stormwater BMPs).
- Incorporate stormwater management information, as appropriate, into several sections of the biological assessment: Project Description, Environmental Baseline, Impact Avoidance and Minimization Measures, and Effects Analysis.
- In the environmental baseline section of the BA, provide a detailed description of the existing stormwater BMPs and the existing habitat of the species addressed in the BA, including details about the receiving water.
- Provide all information associated with the project design, including the proposed BMPs, in the project description:
    - Report stormwater management plans as presented by the project engineer in the *Highway Runoff Manual*/Endangered Species Act checklist
    - Describe proposed stormwater treatment
    - Describe existing stormwater features that will be used
    - Quantify the proposed physical impacts of constructing BMPs.
- Complete an effects analysis:
    - Determine potential exposure based on the presence and life-histories of listed species or Primary Constituent Elements of designated critical habitat, the efficacy of BMPs, the physical scale of the stormwater effluent in the receiving water, and the physical presence of the BMPs.

- ◻ If ESA-listed species or habitats are expected to be affected by stormwater, predict the response of the individuals or habitat affected.
- ◻ Determine whether the predicted response is insignificant, discountable, or beneficial; if possible, quantify the adverse effects.

- ▪ For each listed species, provide an effect determination for stormwater based on the predicted response to impacts:
  - ◻ Identify stormwater activities that are likely to affect an individual animal's ability to survive, reproduce, forage, or seek shelter as those that will result in a *take* (as defined under the ESA).
  - ◻ To determine the overall effect determination for each species addressed in the BA, evaluate these stormwater effect determinations in conjunction with the effect determinations developed for other project elements.

17.1 Stormwater Management for Highway Projects

Among other environmental impacts that are discussed in a BA, the construction of new impervious surface (NIS) has three major environmental impacts that result when it rains:

1. NIS prevents rainwater from infiltrating through the surface and recharging ground water. Minimizing groundwater recharge results in decreases in base flows of nearby surface water.
2. Loss of vegetation and the lack of infiltration result in increases of rainwater that runs along the surface, known as runoff. Increases in runoff result in increased peak flows of receiving waters.
3. The presence of NIS provides a platform that collects settled out air pollutants, contaminants from vehicles and road maintenance practices, and sediment from the surrounding environment. These pollutants are mobile and become a part of the runoff that moves through the watershed.

For purposes of this training manual, the term *stormwater* will be used to generalize all portions of precipitation that does not naturally evaporate or percolate into the ground.

WSDOT incorporates stormwater BMPs into the project design to minimize the above three impacts from NIS. Stormwater BMPs are designed to reduce pollution and attenuate peak flows and volumes associated with stormwater runoff. Some temporary BMPs are used only during the construction phase of a project. The permanent BMPs are used to control and treat runoff throughout operation of the highway, park-and-ride lot, rest area, ferry holding area, or other transportation project site. Although their construction is beneficial because they minimize the environmental impacts of stormwater, stormwater BMPs do not eliminate the impacts.

Projects that include the construction of NIS will need to address the effects of stormwater and the construction of BMPs on species and habitat listed or designated under the Endangered Species Act (ESA). This chapter explains how to assess the impacts of the physical presence of stormwater BMPs, the construction phase of the stormwater BMPs, and the stormwater exiting the BMP at the outfall site. This chapter does not address the selection of BMPs that are incorporated into the project plans. The selection process is outlined in the WSDOT *Highway Runoff Manual*.

17.2 Regulatory Framework for Selection and Application of BMPs

The WSDOT *Highway Runoff Manual* provides uniform technical guidance and establishes minimum requirements for avoiding and mitigating water resource impacts associated with the development of state-owned and operated transportation infrastructure systems, and for reducing and minimizing water resource impacts associated with redevelopment of those facilities.

The *Highway Runoff Manual* meets the level of stormwater management established by the Washington Department of Ecology to achieve compliance with federal and state water quality regulations. These regulations require stormwater treatment systems to be properly designed, constructed, maintained, and operated to achieve the following goals:

- Prevent pollution of state waters, protect water quality, and comply with state water quality standards.
- Satisfy state requirements for all known, available, and reasonable methods of prevention, control, and treatment (AKART) of wastes prior to discharge to waters of the state.
- Satisfy the federal technology-based treatment requirements under 40 CFR 125.3.

The *Highway Runoff Manual* reflects the best available science in stormwater management to ensure that WSDOT projects protect the functions and values of critical environmental areas. WSDOT considers this manual to include all known, available, and reasonable methods of prevention, control, and treatment for stormwater runoff discharges, consistent with state and federal law.

Projects that follow the stormwater BMPs established in the *Highway Runoff Manual* are considered by the Department of Ecology to have satisfied the above requirements, including adherence to the guidance provided for selection, design, construction, implementation, operation, and maintenance of BMPs.

17.3 Stepping through the Stormwater Impact Assessment

17.3.1 What is Included in this Chapter?

This chapter follows the project biologist's step-by-step process for conducting a stormwater impact assessment.

First, the types of projects that should be considered for this assessment are reviewed, and baseline information that the project biologist should gather is outlined. Next comes a summary of WSDOT's existing BMPs based on the *Highway Runoff Manual*. Instructions are then given for incorporating information about the selected BMPs into the project description.

Next, an outline is presented of the steps required in analyzing the effects of stormwater and the stormwater BMPs on listed species and designated critical habitat. Finally, guidance is provided to quantify these effects and make effect determinations in accordance with Section 7 of the ESA.

17.3.2 Which Projects Require a Stormwater Impact Assessment?

Impacts resulting from stormwater and installation and operation of stormwater BMPs should be assessed for every project that is undergoing a Section 7 consultation under the ESA and that is subject to requirements of the *Highway Runoff Manual* (and therefore subject to evaluation of impacts resulting from the required stormwater BMPs).

The *Highway Runoff Manual* has received conditional approval from the Department of Ecology. Therefore, WSDOT projects designed in accordance with BMPs in the *Highway Runoff Manual* and meeting conditions outlined by Ecology will achieve compliance with current federal and state water quality regulations. In addition, county and municipal projects that implement BMPs established in the *Highway Runoff Manual* and meeting additional conditions outlined by Ecology will also achieve compliance with current federal and state water quality regulations (Wallace 2004 personal communication).

The project engineer selects the appropriate BMPs for the project based on requirements and exemptions outlined in the *Highway Runoff Manual*.

17.3.3 Where Does this Information Fit into the Biological Assessment?

The project biologist should integrate discussion about stormwater and the stormwater BMPs into the various sections of the BA, including project description, environmental baseline, and effects analysis. For example, the project biologist should:

- Provide details of the new BMPs in the project description
- Describe any existing BMPs (if applicable) in the environmental baseline

- Assess the potential exposure and predicted response of the species or habitat in the effects analysis.

The following sections step through the process of evaluating stormwater and stormwater BMP effects on species and habitat. The appropriate location for the information in the BA is also suggested.

17.3.4 Stormwater Consultation Approach

A joint *Interim Stormwater Consultation Approach* has been developed by WSDOT and FHWA and is available from WSDOT Environmental Services Office. The guidance is updated regularly as new science surfaces and coordination between WSDOT, FHWA, NOAA, and USFWS advances. This joint FHWA and WSDOT consultation approach consists of grouping projects into three levels of consultation effort, depending on the potential effects of the stormwater. The purpose of grouping projects by their potential stormwater effects is to establish the level of information and analysis necessary to complete ESA consultation. The three levels of consultation effort will require different levels of baseline and project information. Refer to the most recent guidance to determine the level of information needed for the BA.

17.4 Environmental Baseline Information Gathering

17.4.1 Environmental Baseline

Before addressing potential habitat impacts resulting from stormwater and the installation of BMPs, it is important to describe the habitat currently existing in the project location and to consider the likelihood that listed species will be present at times when impacts could affect them. In the environmental baseline section of the BA, provide a detailed description of the existing habitat of the species addressed in the BA. For example, if bald eagles are addressed in the BA, then describe the prey base, vegetation, and existence of fish-bearing streams in the area. Are there waterfowl concentration areas nearby? Are there mature trees available? If salmonids are addressed in the BA, provide more details about the aquatic environment, such as stream type and conditions, including descriptions of substrate conditions, flow conditions (seasonal or perennial), existing water quality, and riparian habitat. If bull trout critical habitat is addressed in the BA, describe the primary constituent elements that currently exist within the area.

The quantity and quality of stormwater will be impacted by variables such as the total amount of impervious surface draining into a BMP. Therefore, it is important to discuss the amount of existing impervious surface in the baseline section of the BA. Also, the level of impact that stormwater has on its receiving water may vary with the quality and quantity of the receiving water. It is important to include the baseline conditions of the existing habitat in your analysis. Also, refer to the *Interim Stormwater Consultation Approach* discussed in Section 17.3.4 to determine other baseline information that should be included.

Providing a thorough baseline in the BA will help you better assess what changes might take place and better support your effects analysis and effect determinations. Section 17.9 of this chapter provides a list of on-line resources that provide baseline information on receiving water including, water quality, flow, and if it is an exempt waterbody.

17.4.2 Existing BMPs at the Project Site

The project biologist should include in the BA as much information as possible about existing stormwater BMPs, including the location of the BMP, locations of outfalls, and the name of the receiving water. This information is critical to the analysis when the project plans include the use of these BMPs. Also, if project plans include the removal, retrofit, or discontinuation of these existing BMPs, make that clear in the project description. This information could affect the overall environmental impact of the project. Details of new BMPs belong in the project description.

17.4.3 Endangered Species Act Stormwater Design Checklist

The project biologist reports stormwater management plans in the BA based on the information presented by the project engineer in the ESA stormwater design checklist. The project biologist may request the project engineer to provide this checklist. The checklist template is available in CHAPTER 3 APPENDIX B (page 3B-1) of the *Highway Runoff Manual* (see Section 17.9, ON-LINE RESOURCES FOR STORMWATER, for the link). The checklist breaks down the analysis of stormwater elements and impacts into "threshold discharge areas" or TDAs. TDAs are those areas on the project site that drain to a natural discharge location(s).

Project plans may also be useful in determining locations of proposed BMPs. These locations must be known in order to assess environmental impacts of the BMPs. The project biologist should be prepared to ask for additional information during or before site visits, because displaced habitat must be identified in the field.

The completed checklist should not be attached to the BA; rather, the information should be presented in the appropriate locations in the BA.

17.5 Summary of WSDOT *Highway Runoff Manual* Stormwater BMPs

There are a total of 28 BMPs (including experimental BMPs) for water quality treatment, and a total of 10 BMPs (including experimental BMPs) for flow control (water quantity). The following subsections briefly describe each type of BMP. For further information, the *Highway Runoff Manual* or the *Hydraulic Manual* should be consulted. These two manuals can be found at <http://www.wsdot.wa.gov/environment/wqec/default.htm>.

17.5.1 BMPs for Stormwater Quality Treatment

17.5.1.1 Infiltration BMPs

Infiltration BMPs for treatment of water quality include the following:

- Infiltration pond
- Infiltration trench
- Infiltration vault.

Infiltration is a preferred method of treatment, offering the highest level of pollutant removal. Treatment is achieved through settling, biological action, and filtration. One important advantage to using infiltration is that it recharges the ground water, thereby helping to maintain summertime base flows in streams and reducing stream temperature naturally. These are important factors in maintaining a healthy habitat for instream biota.

Infiltration facilities must be preceded by a presettling basin to remove most of the sediment particles that would otherwise reduce the infiltrative capacity of the soil. Infiltration strategies intended to meet runoff treatment goals may be challenging for many project locations in western Washington due to their large space requirements and strict soil and water table requirements. Eastern Washington generally offers more opportunities for the use of infiltration BMPs.

17.5.1.2 Dispersion BMPs

Dispersion BMPs include the following:

- Natural dispersion
- Engineered dispersion.

Perhaps the single most effective way of mitigating the effects of highway runoff in nonurban areas is to make use of the pollutant-removal capacity of the existing naturally vegetated area. **Natural dispersion** requires that runoff not become concentrated in any way as it flows into a preserved, naturally vegetated area. The naturally vegetated area must have topography, soil, and vegetation characteristics that provide for the removal of pollutants. Pollutant removal typically occurs through a combined process of vegetative filtration and shallow surface infiltration.

Natural dispersion has several notable benefits: it can be very cost-effective, it maintains and preserves the natural functions, and it reduces the possibility of further impacts on the natural areas adjacent to constructed treatment facilities. In most cases this method not only meets the requirements for runoff treatment but also provides flow attenuation. However, if channelized drainage features are near the runoff areas requiring treatment, then other types of engineered solutions may be more appropriate.

Engineered dispersion techniques use the same removal processes as natural dispersion. For engineered dispersion, a manmade conveyance system directs concentrated runoff to the dispersion area (via storm sewer pipe or ditch, for example). The concentrated flow is dispersed at the end of the conveyance system to mimic sheet-flow into the dispersion area. Engineered dispersion techniques coupled with compost-amended soils and additional vegetation enhance the modified area. These upgrades help to ensure that the dispersion area has the capacity and ability to infiltrate surface runoff.

As with any other stormwater BMP, preservation and maintenance protocols must be followed where dispersion techniques are used. Because the features used to provide treatment are for the most part indistinguishable from other natural or landscaped areas, dispersion areas must be readily identifiable and protected from alteration or destruction by general maintenance practices or future development.

17.5.1.3 Biofiltration BMPs

Biofiltration BMPs include the following:

- Bioinfiltration swale
- Roadside bioretention area (experimental)
- Vegetated filter strip
- Biofiltration swale
- Wet biofiltration swale
- Continuous inflow biofiltration swale
- Ecology embankment
- Compost-amended filter strip.

A **bioinfiltration swale**, a BMP developed and used more commonly in eastern Washington, is categorized in this manual under biofiltration BMPs for convenience and consistency. It actually functions as both a filtering BMP and an infiltration BMP and can therefore provide runoff treatment and flow control in specific circumstances.

A **roadside bioretention area** is characterized as an area with native or amended soils and landscaping, engineered to infiltrate stormwater runoff from the adjacent pavement surface. These facilities are designed to incorporate many of the pollutant-removal mechanisms present in forested ecosystems. Runoff flows to and filters through the plant and soil system.

Bioretention areas, generally located adjacent to pollution-generating surfaces from which runoff should be treated, can also be located adjacent to a conventional stormwater collection system, if needed. A treatment train (i.e., a series of linked landscape elements that reduce stormwater volumes and treat water quality) is recommended, with a vegetated filter strip preceding the bioretention area for pretreatment.

Roadside bioretention areas can typically be applied in various locations: the median, outside shoulder of the roadway, parking lot landscape island, and bridge embankment.

Bioretention areas can remove a wide range of pollutants from stormwater runoff, including total suspended solids (TSS), nutrients, hydrocarbon compounds, and bacteria. Pollutant removal is achieved through physical, biological, and chemical processes occurring within and between the soil, plants, and microorganisms within the bioretention area.

Bioretention functions best in areas providing good soil infiltration (outwash soils) and low ground water levels. Where infiltration is poor (till soils), bioretention benefits are challenging but can be achieved using suitable supplemental storage such as additional gravel base, infiltration chambers, or downstream flow controls. Once established, bioretention areas take care of themselves.

Vegetated filter strips function by slowing runoff velocities, filtering out sediment and other pollutants, and providing some infiltration into underlying soils. Vegetated filter strips consist of gradually sloping areas adjacent to the roadway. As highway runoff drains in sheet-flow from the roadway surface, it flows through the grass filter. The flow can then be intercepted by a ditch or other conveyance system and routed to a flow control BMP or outfall.

Biofiltration swales provide another effective means of removing conventional pollutants and offer a relatively low-cost treatment solution. A biofiltration swale consists of a flat-bottomed, shallow-sloped swale planted with grasses. The swale functions by slowing runoff velocities, filtering out sediment and other pollutants, and providing some infiltration into underlying soils.

Biofiltration swales can also be integrated into the stormwater conveyance system. Existing roadside ditches may be good candidates for upgrading to biofiltration swales. Biofiltration swales are not recommended for use in arid climates. In semi-arid climates, drought-tolerant grasses should be specified.

A **wet biofiltration swale**, a variation of a basic biofiltration swale, is useful where the longitudinal slope is slight, the water table is high, or continuous low base flow tends to cause saturated soil conditions.

Another variation of a basic biofiltration swale is the **continuous inflow biofiltration swale** for applications where water enters a biofiltration swale continuously along the side slope rather than being concentrated at the upstream end.

Some biofiltration BMPs are available that integrate soil amendments into their composition. Soil amendments can use a variety of materials but usually consist of a 2- to 6-inch thick blanket of compost, spread over the existing soil. The application may be left as a blanket or incorporated into the soil to improve soil quality and texture and thus improve infiltration. Soil amendments bind to dissolved metals, while biota in organic soils break down and neutralize the surface runoff pollutants. Soil amendments also have a high capacity to hold moisture (up to 1½ times their weight) and can significantly reduce site runoff.

The **ecology embankment** is a BMP that integrates soil amendments at the pavement edge, providing significant pollution reduction and flow attenuation. Its application is limited to highways located in relatively flat terrain. This BMP can often be constructed with little or no additional right-of-way, making it a cost-effective solution to managing highway runoff.

Another similar and effective BMP using soil amendments is the **compost-amended filter strip**, a design variation on the standard vegetated filter strip. This BMP incorporates compost amendments and subsurface gravel courses to augment the vegetation's basic treatment properties, while also supplementing the need for a flow control system by providing a limited amount of storage.

17.5.1.4 Wet Pool BMPs

Wet pool BMPs include the following:

- Wet pond
- Combined wet/detention pond
- Constructed stormwater treatment wetland
- Combined stormwater treatment wetland/detention pond
- Wet vault
- Combined wet/detention vault.

A **wet pond** is a constructed basin containing a permanent pool of water throughout the wet season. Wet ponds function by settling suspended solids. Biological action of plants and bacteria provides some additional treatment. Not only can wet ponds be designed for the treatment of conventional pollutants, they can also be modified to enhance removal of nutrients or dissolved metals. Wet ponds are usually more effective and efficient when constructed using multiple cells (i.e., a series of individual smaller basins), where coarser sediments become trapped in the first cell, or forebay.

Wet pond designs can also provide flow control by adding **detention** volume (live storage) above the dead storage. Because the function of a wet pond depends upon maintaining a permanent pool of water to provide treatment, this BMP is generally not recommended for use in arid or semi-arid climates.

Cold-climate applications can be problematic, and additional modifications must be considered. The spring snowmelt may have a high pollutant load and produce a larger runoff volume to be treated. In addition, cold winters may cause freezing of the permanent pool or freezing at inlets and outlets. High runoff salt concentrations resulting from road salting may affect pond vegetation, and sediment loads from road sanding may quickly reduce pond capacity.

Constructed stormwater treatment wetlands can be designed for runoff treatment alone or to serve the dual function of runoff treatment and flow control. This BMP is typically constructed as a final water quality BMP that requires collection and conveyance of stormwater to the facility inlet. Sediment and associated pollutants are removed in the first cell of the system via settling. The processes of settling, biofiltration, biodegradation, and bioaccumulation provide additional treatment in the subsequent cell or cells. In general, constructed stormwater treatment wetlands could be incorporated into drainage designs wherever water can be collected and conveyed to a maintainable artificial basin.

Constructed stormwater treatment wetlands offer a suitable alternative to wet ponds or biofiltration swales and can also provide treatment for dissolved metals. The landscape context for stormwater wetland placement must be appropriate for creation of an artificial wetland (i.e., ground water, soils, and surrounding vegetation). Natural wetlands cannot be used for stormwater treatment purposes.

Very few constructed stormwater wetlands exist in Washington state. However, constructed stormwater wetlands can be a preferred stormwater management option over other surface treatment and flow control facilities. In general, this option is a more aesthetically appealing alternative to ponds.

Wet vaults are commonly used in projects with limited space in areas that cannot accommodate a biofiltration swale or a pond. Although wet vaults have minimal right-of-way requirements, they do not offer as much runoff treatment as other BMPs, because sedimentation is the only treatment mechanism. Wet vaults can be difficult to maintain due to poor accessibility and effort needed for visual inspection. Typically, the increased construction and maintenance expenses quickly offset any initial cost benefits derived from smaller right-of-way purchases. Consequently, wet vaults are the least preferred method of runoff treatment.

17.5.1.5 Media Filtration BMPs

Media filtration BMPs include the following:

- Sand filter basin
- Linear sand filter
- Sand filter vault
- StormFilter™.

Media filtration BMPs capture and temporarily store the stormwater runoff and then slowly filter it through a bed of granular media such as sand, organic matter, perlite, soil, or combinations of organic and inorganic materials. In this process, stormwater passes through the filter medium, and particulate materials either accumulate on the surface of the medium (which strains surficial solids) or are removed by deep-bed filtration. Silica sands are relatively inert materials for sorption and ion exchange. However, sands that contain significant quantities of calcitic lime, iron, magnesium, or humic materials can remove soluble contaminants such as heavy metals or pesticides through precipitation, sorption, or ion exchange.

The various types of media filters include vault-contained surface filters, perimeter filters, and modular cartridge filters. In most cases, the filtering action can be combined with a separate facility to provide flow control. Infiltration basins and other infiltration facilities can incorporate sand or other media to improve performance and enhance the pollutant-removal effectiveness of the natural soils. Pretreatment of highway runoff before it is routed to filtration systems requires removal of sediments and floatables to extend the maintenance cycle of the system.

In general, surface sand filters are not recommended where high sediment loads are expected, because sediments readily clog the filter. Sodding the surface of the filter bed can reduce clogging to some degree. This treatment method is not reliable in cold climates because water is unable to penetrate the filter bed if it becomes frozen.

17.5.1.6 Oil Control BMPs

Oil control BMPs include the following:

- Baffle-type oil/water separator
- Coalescing plate separator
- Oil containment boom
- Continuous inlet protection linear sand filter (experimental)
- Bioinfiltration swale (eastern Washington only).

These devices include sorptive oil containment booms, baffle oil/water separators, coalescing plates, sand filters, and catch basin filter media. Oil and grease penetrate the polymer booms at the molecular level. With filters and separators, the oil and grease adhere to device surfaces and are captured on the water surface by baffles or are captured in sediments.

An oil control BMP should be placed as close to the source as possible but protected from sediment. Sorptive oil containment booms can be placed on top of the water in sediment control devices and can be used in ponds and vaults. Baffle oil/water separators, coalescing plate devices, and sand filters should be installed downstream of primary sediment control devices and can be used at pond outlets. Catch basin inserts with sorptive media are appropriate only for the very lowest sediment yield areas because they can easily plug and cause roadway flooding.

With the exception of sorptive booms, these oil control BMPs are expensive to maintain and usually pose safety hazards for maintenance workers, who must work in confined spaces or out in roadway traffic. Moreover, it is difficult to verify whether these BMPs are working effectively.

17.5.2 BMPs For Stormwater Flow Control

Stormwater flow control BMPs are designed to control the flow rate or the volume of runoff leaving a developed site. The primary flow control mechanisms are dispersion, infiltration, and detention. Increased flows can cause downstream damage due to flooding, erosion, and scour, as well as degradation of water quality and instream habitat through channel and stream bank erosion. The following provides an overview of the most commonly used flow control BMPs for highway application.

17.5.2.1   Infiltration BMPs

Infiltration BMPs for flow control include the following:

- Infiltration pond
- Infiltration trench
- Infiltration vault
- Drywell
- Partial infiltration systems, open and closed (experimental).

Infiltration BMPs are established by using an **infiltration pond or trench** and/or a subsurface fluid distribution system. An infiltration pond or trench consists of a shallow impoundment designed to infiltrate stormwater into the soil. A subsurface fluid distribution system may include an assemblage of perforated pipes, drain tiles, or a similar mechanism intended to distribute fluids below the surface of the ground, and it may be subject to underground injection control (UIC) rules. A subsurface fluid distribution system may include an **infiltration trench**, **infiltration vault**, or **drywell**.

An **infiltration pond** is a facility that provides stormwater quantity control by containing excess runoff in a detention facility, then percolating that runoff into the surrounding soil.

An **infiltration trench** (also called an infiltration gallery) consists of a rock-filled trench with no outlet. The trench may incorporate a large underdrain pipe to increase capacity. Runoff is then stored in the pipe and rock voids, and slowly infiltrates through the bottom and sides of the trench and into the soil matrix over a few days. For trenches, this process is also called exfiltration.

An **infiltration vault** is a bottomless (or perforated bottom) underground structure used for temporary storage and infiltration of stormwater runoff to ground water. This type of underground facility can be a useful alternative for sites where constraints make it difficult to site infiltration ponds.

Drywells, which function similar to trenches, are subsurface concrete structures that convey stormwater runoff into the soil matrix. Uncontaminated or properly treated stormwater must be discharged to drywells in accordance with the Ecology UIC program.

Infiltration systems are practical only in areas where the ground water table is sufficiently below the bottom of the facility and in highly permeable soil conditions. Infiltration systems can help recharge the ground water, thus restoring base flows to stream systems. However, to protect the ground water and to prevent clogging of the system, stormwater runoff must first pass through some combination of pretreatment measures, such as a swale or sediment basin, before entering an infiltration system. Compared with other stormwater flow control practices, infiltration systems can be problematic due to siltation.

17.5.2.2 Dispersion BMPs

Dispersion BMPs for flow control include the following:

- Natural dispersion
- Engineered dispersion.

Dispersion BMPs for flow control are discussed in Section 17.5.1.2.

17.5.2.3 Detention BMPs

Detention BMPs include the following:

- Detention pond
- Detention vault
- Detention tank.

Detention facilities generally take the form of either a pond or an underground vault or tank. They operate by providing a volume of live storage with an outlet control structure designed to release flow at a reduced rate over time. A **detention pond** can be configured as a dry pond to control flow only, or it can be combined with a wet pond to also provide runoff treatment within the same footprint.

Detention vaults and tanks are commonly used for projects that have limited space and thus cannot accommodate a pond. Although vaults and tanks require minimal right-of-way, they do not function as well as ponds. Detention vaults and tanks are difficult to maintain due to poor accessibility and effort required for visual inspection. Typically, the increased construction and maintenance expenses quickly offset any initial cost benefits derived from smaller right-of-way purchases. Consequently, underground detention is the least preferred method of flow control.

17.6 Incorporating Proposed BMPs into the Project Description

17.6.1 Proposed Stormwater BMPs

The project description should fully describe the project design, including the BMPs proposed to treat runoff from the new impervious surfaces. Name and describe the BMPs and indicate where are they located, whether they are temporary or permanent, and how they are to be constructed (e.g., heavy equipment, or installed below the surface). Also describe the stormwater conveyance system (i.e., is it an open or closed system). Most of this information is supplied to the project biologist through the ESA stormwater design checklist (see Section 17.4.3).

The project description should identify the BMPs proposed and describe all structural components of each BMP and activities associated with it. Examples include the excavation to install underground pipe that directs runoff from the roadway, construction of a swale that directs runoff from the roadway to the point of discharge, installation of a new outfall or discharge site, installation of riprap at the outlet pipe, or upgrades of an existing detention pond. Describe each BMP in terms of its physical characteristics, location, and whether it is temporary or permanent.

If BMPs already exist at a project site and will not be altered or retrofitted in any way, then information about them, if applicable, should be disclosed in the environmental baseline rather than the project description (e.g., a project site at which existing BMPs will accommodate new impervious surface area). However, if alteration or retrofitting is proposed for existing BMPs, this must be explained in the project description.

Linear projects such as highways often span several drainage basins or watersheds. In these cases, different methods of stormwater treatment may be proposed for new impervious surfaces in different basins. All of these treatment methods should be discussed within the BA.

Following is a list of stormwater treatment BMP information that should be included in the project description in the BA.

- New impervious surface area (acres)
- Existing WSDOT impervious surface area within the project footprint (acres)
- Impervious surface area to be removed (acres)
- Receiving water name
- Proposed BMPs

- Total area of impervious surface draining into each proposed BMP (acres).

The project description should also discuss any flow control or runoff treatment exemptions the project qualifies for, in accordance with the *Highway Runoff Manual* and as presented in the ESA stormwater design checklist. The project description should also include an explanation that the stormwater treatment is consistent with the 2004 *Highway Runoff Manual*, as represented by the project engineer in the ESA stormwater design checklist.

Also, refer to the most current version of the *Interim Stormwater Consultation Approach* discussed in Section 17.3.4 for other project description details that should be included in the BA.

17.6.2 Habitat Impacts from Construction

The construction of a BMP requires space, either on the surface or underground. The installation may require clearing of existing vegetation, in-water work to install an outfall, placement of rock to inhibit erosion or scour at the outfall location, alteration of the landscape or topography, or temporary disturbance to habitat while equipment is placed underground. All of these types of actions should be explained in the project description.

When describing vegetation removal, it is important to quantify the extent of clearing proposed and provide enough detail to support later discussions of how the impacts may affect listed species and habitat. In other words, describe the altered environment in terms of area and habitat type. Is the area proposed for vegetation removal 3 acres of a grassy meadow, an old-growth forest, or manicured turf grass? What are the tree and ground cover species? How big are the trees, and approximately how many will be removed? Describe other types of habitat that will be altered. Is the area a floodplain, near-shore marine habitat, or a talus slope?

Also, the project description should indicate whether the habitat displacement will be temporary or permanent. In the case of temporary displacement of mature vegetation, the impact may not be temporary. For example, project plans may include replacement of trees, but when a 50-year old tree is replaced with a sapling, it is questionable to discount that impact as merely temporary. A project biologist should use best professional judgment when interpreting project plans in this manner.

Below is an example of an inadequate project description for a BA that addresses effects on bald eagles. It is inadequate because it does not describe the vegetation in terms of habitat:

> Installation of the stormwater BMP will require excavation of approximately 1,000 cubic yards of material and removal of 2 acres of vegetation.

Next is an adequately detailed project description in a BA that addresses effects on bald eagles. It is a better description because it describes the vegetation removal in terms of habitat:

> Approximately 1,000 cubic yards of soil will be excavated from the meadow to accommodate the stormwater BMP described above (see attached map for exact location). No trees will be displaced, but approximately 2 acres of grassland vegetation will be removed for this facility.

In summary, for each proposed stormwater BMP, the project description should include details of its effects on habitat in terms of the activity, location, habitat type, terrain, vegetation, and approximate habitat area affected.

17.7 Analyzing the Effects of Stormwater and Stormwater BMPs

The construction of stormwater BMPs are beneficial to the environment by minimizing impacts resulting from the development of pollution-generating new impervious surface. Although BMPs minimize the effects of impervious surface, they are unable to completely eliminate the effects. In addition to the impacts caused by the stormwater, the physical presence of BMPs may also have an impact on listed species or designated critical habitat. As discussed in Section 17.6.2, construction activities may also have impacts that play an important role in the effects analysis. The project biologist should address all three of these stormwater components in the effects analysis.

These three stormwater components may have short-term and long-term direct and indirect effects on the normal behavior of various species or the function of critical habitat. To determine how the stormwater components may affect species or habitat, the project biologist must first determine the extent of exposure to the species or habitat. This section first explains how to determine the exposure based on the efficacy of the proposed stormwater BMPs, the physical scale of stormwater effluent, the footprint of the BMPs, and the presence, life histories, and habitat of ESA-listed species or the primary constituent elements of designated critical habitat. Secondly, we discuss how to apply information about the toxicity of stormwater constituents into your analysis. The project biologist performs this analysis separately for each species addressed in the BA because each species will have a different exposure scenario.

17.7.1 Stormwater Constituents

Stormwater quality can vary from storm to storm and is impacted by several variables. This section presents information on common stormwater constituents and concentrations that are currently of concern to WSDOT prior to treatment by WSDOT BMPs (Table 17-1). These concentrations are based on data from past WSDOT monitoring reports (see ON-LINE RESOURCES FOR STORMWATER in Section 17.9). For the project sites provided in the table, measurements are included for Total Petroleum Hydrocarbons (TPH), Biological Oxygen Demand (BOD), Total Dissolved Solids (TDS), Total phosphorus, orthophosphorus, nitrite and nitrate, Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), water hardness, and total and dissolved cadmium, copper, lead, and zinc.

Table 17-1. Common Stormwater Constituents and Concentration Levels Based on WSDOT's 2002 NPDES Progress Report

TABLE 7-1. SUMMARY OF RESULTS FROM STORMWATER CHARACTERIZATION MONITORING PERFORMED MAY 2002 - MAY 2003

Parameters	I-5			SR 101			SR 8			CALTRANs (5) reference
	Range (1)	No. of Samples	Mean (2)	Range	No. of Samples	Mean	Range	No. of Samples	Mean	Mean
TPH (Mg/L)	ND	7	ND	ND (3)	9	ND	ND	8	ND	NA
BOD (Mg/L)	5.0-15.9	7	8.37	ND-6.24	7	3.83	ND-5	6	2.50	NA
TDS (Mg/L)	ND-96.0	10	52.7	ND-66.0	9	38.7	ND-26.0	5	16.8	109.4 (mg/l)
T. Phosphorus (Mg/L)	ND-0.16	11	0.089	ND-0.15	11	0.05	ND-11.00	7	1.59	0.26 (mg/l)
Ortho-phosphorus (Mg/L)	ND	5	0.08	ND-0.15	5	0.09	ND-.176	3	0.04	NA
Nitrite + Nitrate (Mg/L)	ND-1.43	7	0.93	ND-.8	5	0.26	ND-.2	3	0.75	NA
COD (Mg/L)	54.0-130.0	10	73.5	13.0-82.0	9	47.6	13-59	6	20.8	117.9 (mg/l)
TSS (Mg/L)	3-160	11	81	4-136	11	50	2-15	7	7.14	76 (Mg/l)
Hardness (4) (Mg/L)	5.3-32.0	11	20.4	8.2-22.0	11	15.5	3.2-8.4	7	5.6	58.4 (mg/l)
Total Cadmium (Ug/L)	ND-1.80	11	0.76	ND-.57	11	0.29	ND-0.26	7	0.12	4.5 (Ug/L)
Dissolved Cadmium (Ug/L)	ND-0.76	11	0.33	ND-0.24	11	0.11	ND	7	0.16	0.33 (Ug/l)
Total Copper (Ug/L)	ND-58.00	11	28.18	ND-20.00	11	10.61	ND-5.40	7	2.91	4.85 (Ug/L)
Dissolved Copper (Ug/L)	ND-21	10	7.85	ND-8.00	11	5.85	ND	7	2.50	14.4 (Ug/l)
Total Lead (Ug/L)	ND-22.00	11	12.62	ND-39	11	12.72	ND-2.20	7	1.10	113.6 (Ug/L)
Dissolved Lead (Ug/L)	ND	9	0.5	ND-4.40	11	0.85	ND	7	0.44	4.68 (Ug/l)
Total Zinc (Ug/L)	7.3-220	11	129.70	26.00-170.00	11	61.90	ND-10	7	7.90	227.5 (Ug/L)
Dissolved Zinc (Ug/L)	ND-130	11	64.22	13.00-48.00	10	26.70	ND-8.90	7	5.03	73.7 (Ug/l)

(1) Range in measurements. (ND denotes values were measured that were below the detection limit.)
(2) Mean for all sampling dates. Samples that were below detection (<) were included in calculation of the mean by dividing the detection limit by 0.5.
(3) Range when all values are below detection limit
(4) Hardness values were used to calculate water quality limits for dissolved metals,
(5) Source: http://www.forester.net/sw_0103_caltran.html. Data from 1999-2000 California highway runoff character (Kayhanian et al., 2001)

17.7.2 BMP Efficacy

Predict the effectiveness of each proposed BMP by evaluating the most current WSDOT National Pollutant Discharge Elimination System (NPDES) Progress Report. This report is available on the WSDOT website (also see ON-LINE RESOURCES FOR STORMWATER in Section 17.9 for link). Be aware that these reports present BMP effectiveness in terms of percentages (concentration of constituent going into BMP / concentration of constituent coming out of BMP). Therefore, "effectiveness" measured in this way can increase or decrease with intensity of storm or changes in other variables that impact stormwater quality. Your prediction of BMP efficacy will be a rough estimate. When conducting an analysis on large scale projects in the future, WSDOT may resort to computer-aided modeling.

17.7.3 Determining Physical Scale of Stormwater Effluent in Receiving Water

The physical scale of the stormwater impacts, or plume size, in the receiving water would only need to be determined if measurable effects to listed species or designated critical habitat is expected. In cases where significant impacts are predicted, the scale may need to be determined using computer-aided modeling, which takes into consideration the movement of chemicals, water, and substrate and receiving water chemistry.

Timing is an important part of determining if measurable effects to listed species or designated critical habitat is expected. Water will only be discharged into receiving water when the rainfall event exceeds the capacity of the BMP. Some BMPs may never discharge to the receiving waters. Open systems, such as a vegetated bioswale, will allow for evapotranspiration and infiltration, reducing the amount of stormwater which could potentially enter the receiving water. Interestingly, WSDOT monitoring data indicates that the dirtiest input and output from the BMP's in Washington is not during the expected first flush or first rain event in the fall, but during the month of March. All these factors are taken into consideration in the analysis. Flow alterations can also affect species and habitat as well and should be included in this analysis. Use the Exempt Surface Waters List (see On-line Resources in section 17.9) to determine if effects will be discountable.

When determining scale, include details about the physical presence of the BMP as well. The location of BMPs may increase or decrease potential risks to species or habitat (see also BARRIERS discussion in Section 17.7.6 and outfall location discussion in Section 17.7.7).

17.7.4 Bioavailability

Bioavailability is a critical component of the effects analysis. Exposure is minimized or eliminated if the stormwater constituents are not biologically available to the species. The fate of the stormwater constituents in the receiving water will vary based on their chemistry and the chemistry of the receiving water. Some chemicals may bind tightly to sediment and eventually settle into the substrate; therefore, only temporarily available to some species. Only fish species and habitat components that are closely associated with the substrate are likely to be exposed through absorption or ingestion. Then, depending on the environmental and biological fate of the chemical of concern, exposure to other species may occur through food web interactions.

Some stormwater constituents may remain in the water column and be more available to species that use the site. Depending on the species length of time at the site and their life stage, they may be exposed through absorption and ingestion. Again, depending on the environmental and biological fate of the chemical of concern, exposure to other species may occur through food web interactions.

17.7.5 Overlap of BMPs with Species Area Utilization Map

Based on environmental baseline information already gathered, the project biologist can draw an area utilization map for each listed species and critical habitat, based on the timing of species presence in the project area and the life stage and activity of the species at the time it is present. Overlay this species area utilization map on the impact zone from the stormwater and the proposed new and altered stormwater BMPs. The locations where the species map overlaps with the impact zones determine the extent of exposure.

In the effects analysis section of the BA, the project biologist should describe the exposure in terms of space, time, and the life history of the species. This process should be replicated for each species addressed in the BA.

17.7.6 Barriers to Fish and Wildlife Movement

The effects analysis section of the BA should also describe new or modified BMPs that will inhibit movement of ESA-listed species. Will changes in flow or turbidity prevent use of an area by fish species? Will presence of a new BMP prevent listed birds from foraging or nesting? Describe the extent of the barrier (e.g., partial, permanent, or seasonal barrier).

17.7.7 Impacts at Outfall Locations

The location of the outfall (described in the project description) is an important part of the exposure analysis. The outfall location may increase the extent of exposure of ESA-listed species or habitat due to temporary increases in turbidity, permanent placement of riprap in a riparian area or within the stream channel, or in-water work necessary during construction of a new outfall. If any of these types of environmental impacts overlap with habitat or species utilization areas, the project biologist should discuss whether the impact is temporary or permanent.

17.7.8 Temporary Construction Impacts

Construction activities required for installation of stormwater BMPs may result in sedimentation, removal of riparian vegetation, and other impacts. If these impacts overlap with the habitat or species utilization areas, the project biologist should discuss whether the impact is temporary or permanent.

17.7.9 Toxicity of Stormwater Constituents

The toxicity of the stormwater constituents is species-specific and effects may be visible at various levels of biological organization (i.e., on a molecular, cellular, tissue, or whole-organism level). Often, research has not been conducted on ESA-listed species and results must be extrapolated based on physiological and environmental similarities. Laboratory studies are extremely useful due to the ability to control for multiple variables, thus providing the ability to determine cause-and-effect relationships.

However, as the historical toxicologist, Paracelsus, infamously spoke, *the poison is in the dose*. Simply being exposed to the stormwater constituents is not going elicit an adverse effect. The concentration and routes of exposure are the key variables to determine the level of an effect. Some stormwater constituents, such as dissolved copper and zinc, are considered "of concern" due to their toxicities at low and environmentally relevant doses, assuming the species at risk is present and the stormwater constituents are biologically available.

17.8 Factoring Stormwater Impacts into Effect Determinations

The BA provides a single effect determination for each listed species, which take into account the effects of the entire project including stormwater and new and modified stormwater BMPs. As a preliminary step in reaching that determination, the project biologist focuses on assessing just the stormwater portion of the environmental effects and makes an effect determination for each species or habitat. In the BA, these stormwater-specific effect determinations are then considered in conjunction with all of the effect determinations generated for other project elements (e.g., noise, in-water work, indirect effects, etc.) to arrive at a single overall effect determination for each species addressed in the BA.

17.8.1 Determination of *No-Effect* Based on No Exposure

If listed habitat and species utilization areas do not overlap with the stormwater or BMP footprint, then the species and habitat will not be exposed. For example, projects that result in no net increase of pollutants to the receiving water and have no effect on flow in receiving water will have no stormwater impacts on listed species or habitat. If species or habitat is not exposed to the stormwater or new or modified BMPs, a *no-effect* determination is warranted for this element of the project.

To reach this effect determination, the project biologist has provided all the content recommended in the *Interim Stormwater Consultation Approach* discussed in Section 17.3.4 and has well documented the mapping overlay procedure described in Section 17.7.5. Remember that the overall effect determination for each species is based on effects of the entire project, not just the stormwater and stormwater BMPs.

17.8.2 Determination of *May Affect, Not Likely to Adversely Affect*

Where the effects of the stormwater BMPs on a listed species or habitat are judged to be beneficial, discountable, or insignificant, a *may affect*, *not likely to adversely affect* determination is warranted for the stormwater element of the project. Stormwater impacts that are beneficial, discountable, or insignificant will be dependent upon project conditions, receiving waterbodies, stormwater treatment levels, baseline conditions, and presence of species or habitat.

A project biologist who has reached this effect determination has provided all the content recommended in the *Interim Stormwater Consultation Approach* discussed in Section 17.3.4 and has clearly outlined the footprint of the BMPs in the project description, including temporary and permanent facilities, outfall locations, and any BMPs that connect the two. The project biologist has also identified the habitat availability and historical use by the species in the environmental baseline, and has documented the extent of exposure in the effects analysis. All predicted effects have been adequately supported and identified as beneficial, discountable, or insignificant in the effects analysis.

17.8.2.1 Beneficial Effects

A beneficial effect (without any adverse effects) does not qualify for a *no-effect* determination. If the BMPs will have only beneficial effects and no adverse effects on a listed species or habitat, then a *may affect, not likely to adversely affect* determination is warranted for the stormwater element of the project.

17.8.2.2 Discountable Effects

If the project biologist determines that a predicted effect of the stormwater and stormwater BMPs is extremely unlikely to occur, and this can be supported with best available science, then the effect is discountable. For example, effects may be discountable if the species or habitat is extremely unlikely to be present. The rationale for concluding that the effects are discountable must be explained in the effects analysis. Where the effects are discountable, *a may affect, not likely to adversely affect* determination is warranted for the stormwater element of the project.

17.8.2.3 Insignificant Effects

Perhaps exposure to the stormwater or stormwater BMPs is likely, but the response of the listed species or habitat is expected to be so small that it cannot be meaningfully measured, detected, or evaluated. In this case, the project biologist should explain the rationale for concluding that the effects are insignificant in the effects analysis. Where the effects are insignificant, a *may affect, not likely to adversely affect* determination is warranted for the BMP element of the project.

17.8.3 Determination *of May Affect, Likely to Adversely Affect*

17.8.3.1 Quantifying Adverse Effects on Species

If an effect is not beneficial, discountable, or insignificant, then it is an adverse effect. Adverse effects can be either direct impacts on the listed species or indirect impacts on its habitat or prey species. Stormwater impacts that result in measurable adverse effects to listed species or critical habitat may include projects that create significant amounts of NIS in watersheds with degraded baselines and that support listed species. These assessments must be supported by pertinent baseline information on the habitat elements, species life history, and number of individuals that may be affected.

Stormwater and stormwater BMP impacts that are likely to affect an individual animal's ability to seek shelter, forage, reproduce, or survive are the effects that result in *take*. These are the endpoints used to quantify the adverse effect on a species. The BA's environmental baseline information on the species must support the project biologist's conclusion regarding the significance of the adverse effect and the level of *take* expected.

Indirect and direct effects on listed species and critical habitat that are not beneficial, discountable, or insignificant warrant a *may affect, likely to adversely affect* determination for the stormwater element of the project. A project biologist who has reached this effect determination has provided all the content recommended in the *Interim Stormwater Consultation Approach* discussed in Section 17.3.4 and has clearly outlined the BMP footprint in the project description, including temporary and permanent facilities, outfall locations, and any BMPs that may connect the two. The project biologist has also identified the habitat availability and historical use by the species in the environmental baseline, and has documented the extent of exposure of the stormwater and proposed stormwater BMPs in the effects analysis. Finally, all predicted impacts on an individual animal's ability to survive, reproduce, forage, or seek shelter are supported with best available science and are addressed in the effects analysis.

17.8.4 *Jeopardy* Determination

If an adverse effect is significant enough (i.e., if an entire subpopulation will be adversely affected), then the proposed action may jeopardize the continued existence of the species. A jeopardy determination applies only to species that are *proposed* for listing under the ESA. For a negative jeopardy determination, the BA includes the statement "The project is not likely to jeopardize the continued existence of the species."

Only in the rarest case would a WSDOT project jeopardize the continued existence of a species proposed for listing. A project biologist who believes that a project might jeopardize a proposed species should consult the WSDOT Environmental Office.

17.8.5 *Adverse Modification* Determination

An adverse effect is considered an *adverse modification* if it destroys the conservation value of an entire critical habitat unit (e.g., the bull trout Puget Sound habitat unit). An adverse modification determination applies to proposed or designated critical habitat units. For a negative adverse modification determination, the BA includes the statement "The project is not likely to adversely modify the critical habitat unit."

It is possible for a project to have an adverse effect on any or all of the primary constituent elements yet not reach the level of an adverse modification to the critical habitat unit. Only in the rarest case would a WSDOT project adversely modify a proposed or designated critical habitat unit. A project biologist who believes that a project might adversely modify a critical habitat unit should consult the WSDOT Environmental Office.

17.9 On-line Resources for Stormwater

17.9.1 WSDOT Resources

WSDOT Highway Runoff Manual
<http://www.wsdot.wa.gov/environment/wqec/hrm_resource.htm>.

Exempt Surface Waters List (updated 09/15/04)
<http://www.wsdot.wa.gov/environment/wqec/docs/TCpostpubHRMtable0205.PDF>.

WSDOT NPDES Progress Reports
<http://www.wsdot.wa.gov/environment/wqec/wqec_npdes.htm>.

17.9.2 Baseline Soil/Water Quality and Stream Flow Information

Washington Ecology – River and Stream Water Quality Monitoring
<http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html>.

Snohomish County – Surface Water On-line Data
<http://198.238.192.103/spw_swhydro/wq-search.asp>.

USGS National Water Quality Assessment Program – Data Warehouse
<http://infotrek.er.usgs.gov/traverse/f?p=NAWQA:HOME:7497878595394337582>.

Washington State's Water Quality Assessment
<http://www.ecy.wa.gov/programs/wq/303d/2002/2002-index.html>.

Department of Ecology 303d List
< http://www.ecy.wa.gov/programs/wq/303d/index.html>

Limiting Factors Analysis by Washington State Conservation Commission
< http://salmon.scc.wa.gov/>

Background Soil Metals Concentrations for Washington State
Publication #94-115
< http://www.ecy.wa.gov/pubs/94115.pdf>

17.9.3 Water Quality Standards

U.S. EPA Water Quality Standards
<http://www.epa.gov/waterscience/standards/>.

State Water Quality Standards
< http://www.ecy.wa.gov/programs/wq/standards/index.html>

17.9.4 Current Research

WSDOT – Current Stormwater Research
<http://www.wsdot.wa.gov/environment/stormwater/default.htm>.

USGS National Water Quality Assessment Program
<http://water.usgs.gov/nawqa/>.

USGS National Highway Runoff
Water-Quality Data and Methodology Synthesis
<http://ma.water.usgs.gov/fhwa/biblio/default.htm>.

Washington Ecology – Whole Effluent Toxicity (WET) Testing
<http://www.epa.gov/waterscience/standards/>.

Northwest Fisheries Science Center
<http://www.nwfsc.noaa.gov/publications/displayinclude.cfm?incfile=journalarticlein_press.inc>.

Society of Environmental Toxicology and Chemistry (SETAC)
< http://www.setac.org/>

Aquatic Toxicology journals – no specific on-line ability to search